WASHINGTON NATURAL HERITAGE PROGRAM

**Hanford Endemic Plants
Population Monitoring
1997-2012**

Prepared for
U.S. Fish and Wildlife Service

Prepared by
Joseph Arnett
April 18, 2013

Natural Heritage
Report 2013-07

WASHINGTON STATE DEPARTMENT OF
Natural Resources

Hanford Endemic Plants
Population Monitoring

Umtanum desert-buckwheat (*Eriogonum codium*)
and
White Bluffs bladderpod (*Physaria douglasii* ssp. *tuplashensis*)

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Acknowledgements

Contents

Tables

Table 1. Summary of dates and participants in *Eriogonum codium* monitoring, 2008-2012
Table 2. *Eriogonum codium* seedling data from 1997-2012
Table 3. *Eriogonum codium* census data from 1995, 1997, 2005, and 2011

Appendices

Appendix A: *Eriogonum codium* data for population viability analysis, 1997-2012
Appendix B: Newsome update on the current status of *Physaria douglasii* ssp. *tuplashensis*
Appendix C: Monitoring Methodology for *Eriogonum codium* Population Viability Analysis

Introduction

This report documents monitoring of two plant species, *Eriogonum codium* (Umtanum desert buckwheat) and *Physaria douglasii* ssp. *tuplashensis* (White Bluffs bladderpod), within the Hanford Reach National Monument between 2008 and 2012. This work is a continuation of research on these two species previously reported in Arnett (2012), Beck (1999a), Caplow (2003), and Dunwiddie et al. (2000), and continuing through 2012 under Section 6 Segment 73. Newsome (2012) prepared the report on annual *Physaria douglasii* ssp. *tuplashensis* monitoring.

Eriogonum codium and *Physaria douglasii* ssp. *tuplashensis* are both currently at risk because of their limited distribution, relatively small population sizes, and vulnerability to environmental and human-caused perturbations. They were both proposed as threatened under the Endangered Species Act on May 15, 2012. The Fish and Wildlife Service is also proposing to designate critical habitat for each species, approximately 344 acres for *Eriogonum codium* and approximately 2,861 acres for *Physaria douglasii* ssp. *tuplashensis* (Federal Register 2012).

Eriogonum codium

Eriogonum codium has been proposed for federal listing as threatened under the Endangered Species Act (Federal Register 2012) and is designated as a state endangered species in Washington (Washington Natural Heritage Program 2013). This species was described in 1995 by Reveal, Caplow, and Beck (Reveal et al. 1995). The global extent of the species consists of approximately 5,000 plants occurring along a one-mile linear area on Umtanum Ridge. It is not closely related to any other Washington species of *Eriogonum* (Reveal et al. 1995). It forms low mats up to 1 meter in diameter.

Monitoring and Population Viability Analysis

E. codium has been the subject of intensive demographic monitoring since 1997. Within the projects reported here, the WNHP coordinated and led annual Umtanum desert buckwheat monitoring in 2008-2012. Table 1 presents a summary of dates and participants in monitoring:

Table 1. Summary of dates and participants in *Eriogonum codium* monitoring, 2008-2012.

year	Seedling monitoring		PVA monitoring	
	date	participants	date	participants
2008	May 15	Joe Arnett(WNHP), Mark Darrach (volunteer), and Carrie Cordova (FWS)	July 10	Joe Arnett, Mark Mease (volunteer), and Cleon Rice, Tim McCracken, Kevin McCarthy, Heidi Newsome, and Carrie Cordova (FWS).
2009	May 6	Joe Arnett	July 9	Joe Arnett, Mark Darrach, Ben Grady (University of Wisconsin), Laci Bristow (FWS), Heidi Newsome, and Carrie Cordova.
2010	April 29 & 30	Joe Arnett, Mark Darrach, Lisa Saperstein and Wendy Mee (Yakima Training Center), Terri Knoke (volunteer), and Janelle Downs (Pacific Northwest National Laboratory).	July 7	Joe Arnett, Mark Darrach, Jane Abel and Lisa Hill (volunteers), and Heidi Newsome.
2011	April 28	Joe Arnett, Terri Knoke, Lorraine Seymour, Jane Abel, and Keith Abel (volunteers).	July 7	Joe Arnett and Jodi Bush, Carrie Cordova, Kathleen Fulmer, Jessica Gonzales, Tim McCracken, Ralph Thompson, Heidi Newsome, Ted Thomas.
2012	May 3	Keith Abel, Joe Arnett, Mark Darrach, Larry Klimek, Heidi Newsome, Lorraine Seymour	July 9	Jane Abel, Keith Abel, Joe Arnett, Lisa Dunham, Jennifer Lannoye, Wendy Mee, Heidi Newsome.

Initial findings from 1997 through 1999 were reported in 2000 (Dunwiddie *et al.* 2000). In 2000, researchers concluded, based on counting the annual rings on dead plants, that *Eriogonum codium* is a long lived species (greater than 100 years) with high flower production, low germination rates, high seedling mortality, and high variability of growth between individuals and years. Seedling data from 1996-2012 is presented in Table 2; the counts in this table demonstrate the extreme variation in seedling production. The data in Appendix A show very low survival of seedlings beyond the spring in which they germinate.

Table 2. *Eriogonum codium* seedling data from 1997-2012.

year	seedling count	year	seedling count	year	seedling count	year	seedling count
1996	4	2001	37	2006	5	2011	79
1997	26	2002	0	2007	154	2012	6
1998	3	2003	3	2008	12		
1999	20	2004	6	2009	5		
2000	73	2005	0	2010	67		

Within the permanent monitoring plots, mortality consistently far exceeded recruitment between 1997 and 2012.

E. codium appears to be in very gradual decline. Kaye (2007) reported an annual decline, and calculated a rate, for the years monitored, of about 2/3 of one percent. A projection of the population from 1997 for 100 years suggests that the population may decline over time modestly or greatly, and that it is unlikely to grow substantially if current conditions remain the same.

Appendix C provides a revised methodology for monitoring *E. codium* for PVA. In this we have incorporated changes in plant tag numbers, corrections in the plot diagrams, and clarified the descriptions of transect and plot locations.

Census

A census of the global extent of *Eriogonum codium* was first made in 1995, and repeated, with more precision, in 1997 (Beck 1999). Repeat counts of the entire species were made in 2005 and 2011; these counts are summarized in Table 3. While these counts are done by examining and flagging each individual plant, in some cases it is impossible to tell, without damaging the plant, whether a clump consists of more than one individual. This was made evident by rarely occurring pale flowered individuals. In a few cases these individuals grew tightly together with a normal yellow flowered individual, and that there were two individuals present was only discernible because of the differences in flower color. These two individuals would have likely been counted as one. Conversely, occasionally individual plants were found with spreading connecting branches that had been buried. In these cases, one individual may have been counted as two or more. These instances were not common, the two situations would tend to cancel each other out, and we regard these counts as fairly precise. However, because of different interpretations of individual plants and clusters, and because of uncertainty about whether all the outlying clusters were included in every census, we do not interpret the variation from census to census as a precise record of changes in population size.

Table 3. *Eriogonum codium* census data from 1995, 1997, 2005, and 2011.

Census year	Population count, species wide
1995	4,900
1997	5,207
2005	4,408
2011	5,169

Physaria douglasii **ssp.** *tuplashensis*

White Bluffs bladder-pod is a low-growing, herbaceous, short-lived, perennial plant in the Brassicaceae (mustard family). It is known from a single population that occurs along the lip of the White Bluffs, above the Hanford Reach, between 30 and 40 feet wide and extending for

approximately 11 miles. The species occurs only in the caliche (a cemented calcium carbonate material) layer exposed at the lip of the bluffs. Threats to the species include landslides (apparently caused or increased by groundwater from nearby irrigation), fire, direct impacts from off-road vehicles, and invasive non-native plants (Federal Register 2012).

Taxonomic Changes

Physaria douglasii ssp. *tuplashensis* was originally described as *Lesquerella tuplashensis* by Rollins, Beck, and Caplow in 1996. Their research recognized that while *L. tuplashensis* and *L. douglasii* were quite similar, they differed sufficiently, morphologically and phenologically, to warrant recognition as two distinct species. In 2002, Al-Shehbaz and O'Kane (2002). recommended that the genera *Lesquerella* and *Physaria* be united as *Physaria*. They did not feel that the morphological analysis of Rollins et al. (1996) justified the recognition of *Lesquerella tuplashensis* at the species level, and they recommended that *Lesquerella tuplashensis* should be recognized at the subspecific level as *Physaria douglasii* subspecies *tuplashensis*.

Monitoring

Monitoring has been conducted since 1997 along permanent transects along the northern portion of the population according to a protocol described in Beck (1999). Heidi Newsome, a biologist with the U.S. Fish and Wildlife Service, has been leading that monitoring. The most recent summary of the results of that effort is included in Appendix B.

References

Al-Shehbaz, I.A. and S.L. O'Kane. 2002. *Lesquerella* is united with *Physaria* (Brassicaceae). *Novon* 12: 319-329.

Arnett, J. 2012. Hanford endemic plants, population monitoring. Natural Heritage Report 2012-01, January 17, 2012. Washington Natural Heritage Program, Olympia.

Beck, K. 1999a. Research and overview of *Eriogonum codium*, 1995-1998. Prepared for The Nature Conservancy of Washington by Kathryn Beck, Calypso Consulting, August 1999.

Beck, K. 1999b. Research and overview of *Lesquerella tuplashensis*, 1994-1998. Prepared for The Nature Conservancy of Washington by Kathryn Beck, Calypso Consulting, August 1999.

Caplow, F. 2003. Studies of Hanford Rare Plants, 2002. Prepared for Washington office of The Nature Conservancy. Natural Heritage Report 2003-04. Washington Natural Heritage Program, Washington Department of Natural Resources. March 2003.

Caplow, F, T.N. Kaye, and J. Arnett. 2007. Population Viability Analysis for *Eriogonum codium* (Umtanum desert buckwheat). Prepared for the U.S. Fish and Wildlife Service under Section 6 funding. Natural Heritage Report 2007-04, Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington. June 30, 2007.

Dunwiddie, P.W., K.A. Beck, and F.E. Caplow. 2000. Demographic studies of *Eriogonum codium* Reveal Caplow & Beck (Polygonaceae) in Washington. In: Reichard *et al.* editors. *Conservation of Washington's native plants and ecosystems*. Washington Native Plant Society, Seattle, Washington.

Dunwiddie, P.W., K.A. Beck, and F.E. Caplow. 2001. Demographic studies of *Eriogonum codium* Reveal, Caplow & Beck (*Polygonaceae*) in Washington. <u>In</u> Conservation of Washington's Rare Plants and Ecosystems: Proceedings from a conference of the Rare Plant Care and Conservation Program of the University of Washington. Washington Native Plant Society, Seattle, Washington.

Federal Register. 2012. Endangered and threatened wildlife and plants; threatened status for *Eriogonum codium* (Umtanum desert buckwheat) and *Physaria douglasii* ssp. *tuplashensis* (White Bluffs bladderpod). Federal Register 77 (94): 28704. May 15, 2012.

Kaye, T.N. 2007. Draft population viability analysis for *Eriogonum codium* (Umtanum buckwheat). Prepared for the Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, WA by Thomas N. Kaye, Institute for Applied Ecology, Corvallis, Oregon. January 2007.

Newsome, H. 2012. Update of the current status of *Physaria douglasii* ssp. *tuplashensis* on the Hanford Reach National Monument (2012). Unpublished U.S. Fish and Wildlife Service report. U.S. Fish and Wildlife Service Mid-Columbia River NWRC, Burbank, WA.

Reveal, J. L., F. Caplow, and K. Beck. 1995. *Eriogonum codium* (Polygonaceae: Eriogonoideae), a new species from southcentral Washington. *Rhodora* 97(892): 350–356.

Rollins, R.C., K.A. Beck, and F.E. Caplow. 1995. An undescribed species of *Lesquerella* (Cruciferae) from the state of Washington. *Rhodora* 97 (891): 201-207.

Washington Natural Heritage Program. 2013. List of vascular plants tracked by the Washington Natural Heritage Program. At http://www1.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html. Accessed April 16, 2013.

Appendix A

Compiled *Eriogonum codium* data
for
population viability analysis

1997-2012

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1=Top; 2=Slope	x-axis	y-axis	1997					1998				
					Length	Width	% Dead	97 Area	97 #Infl	Length	Width	% Dead	98 Area	98 #Infl
10206	17	1												
10206	56	1	44	45	12	8	16	75	1	12	8	16	75	1
10206	69	1	59	65	22	17	63	294	7	25	16	63	314	0
10206	70	1	75	53	21	21	3	346	28	20	14	16	220	0
10206	71	1	69	6	22	15	16	259	18	22	15	3	259	9
10206	72	1	101	55	9	8	3	57	1	11	8	16	69	0
10206	73	1	55	56	9	8	16	57	2	8	7	38	44	0
10206	74	1	50	21	24	18	16	339	15	25	19	3	373	20
10206	75	1	179	49	14	13	3	143	12	16	13	3	163	0
10206	76	1	83	98	17	13	16	174	2	15	10	16	118	0
10206	77	1	82	65	18	10	2	141	0	18	10	16	141	1
10212	78	2	192	35	14	10	16	110	6	14	10	38	110	1
10212	79	2	184	11	19	18	16	269	32	18	18	16	254	4
10212	80	2	147	98	44	21	3	726	195	44	21	3	726	45
10212	82	2	118	20	26	26	3	531	21	25	22	16	432	4
10212	83	2	101	34	46	42	3	1517	1	44	39	38	1348	1
10212	84	2	138	27	10	8	3	63	1	12	8	16	75	0
10212	85	2	169	12	29	16	16	364	14	30	14	16	330	2
10401	1	1	0	15	60	37	2	1744	78	60	38	3	1791	98
10401	3	1	194	98	11	10	1	86	0	13	9	3	92	0
10416	4	2	47	67	30	20	16	471	0	30	23	16	542	37
11403	5	1	16	18	14	10	1	110	0	13	11	63	112	0
11403	6	1	52	2	30	27	1	636	97	31	26	16	633	64
11403	7	1	53	10	28	22	3	484	30	29	25	38	569	8
11403	8	1	90	44	22	19	1	328	21	23	19	16	343	8
11403	9	1	103	22	21	17	1	280	19	21	16	1	264	0
11403	10	1	141	0	17	10	3	134	2	18	12	38	170	5
11403	11	1	162	5	28	26	16	572	71	26	20	38	408	25
11403	195													
11407	12	2	43	43	23	16	16	289	16	24	17	16	320	19
11407	13	2	57	50	20	16	1	251	15	24	18	3	339	27
11407	14	2	71	50	19	15	3	224	0	21	17	16	280	19
11407	15	2	58	73	27	12	88	254	0	27	12	88	254	0

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1999					2000					
		Length	Width	% Dead	99 Area	99 #Infl	Length	Width	% Dead	00 Area	00 #Infl	Notes
10206	17											
10206	56	12	8	16	75	0	13	9	38	92	0	
10206	69	26	17	63	347	0	24	18	63	339	0	
10206	70	19	13	16	194	0	18	12	15	170	8	infl very small
10206	71	22	17	16	294	0	21	17	15	280	0	
10206	72	11	8	16	69	0	11	8	63	69	0	
10206	73	9	8	38	57	0	9	7	38	49	0	
10206	74	26	21	38	429	1	25	21	15	412	8	2-3 flwrs/infl
10206	75	15	12	16	141	0	15	13	15	153	0	
10206	76	15	13	38	153	0	7	3	63	16	0	
10206	77	18	11	16	156	0	19	10	15	149	0	
10212	78	15	13	16	153	0	16	13	38	163	3	1-3 flwrs/infl
10212	79	20	20	16	314	2	21	19	15	313	2	
10212	80	45	24	38	848	9	42	24	15	792	52	some infls very small
10212	82	26	23	16	470	1	17	11	63	147	3	
10212	83	46	38	38	1373	0	46	40	15	1445	0	
10212	84	12	8	38	75	0	12	9	15	85	0	DON'T USE FOR ANALYSIS
10212	85	32	14	38	352	0	30	14	38	330	3	
10401	1	63	42	38	2078	30	55	42	15	1814	49	healthy infl
10401	3	13	10	3	102	0	13	11	15	112	0	
10416	4	32	23	3	578	33	40	28		880	76	some still emerging, healthy
11403	5	14	9	63	99	0	14	9	63	99	0	
11403	6	31	26	16	633	15	32	27	15	679	10	poor quality infl
11403	7	27	20	38	424	0	29	19	63	433	0	
11403	8	24	20	38	377	2	23	20	38	361	0	
11403	9	20	15	3	236	0	21	17	3	280	0	
11403	10	6	3	88	14	0	16	9	88	113	0	
11403	11	24	19	63	358	3	28	26	63	572	33	poor quality infl, tag missing
11403	195											
11407	12	25	16	3	314	7	28	16	15	352	32	medium quality flwrs
11407	13	25	18	3	353	16	26	18	15	368	2	
11407	14	20	17	3	267	3	20	18	15	283	3	
11407	15	23	11	88	199	0	23	11	88	199	0	very few surviving leaves

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2001						2002					
		Length	Width	% Dead	01 Area	01 #Infl	Notes	Length	Width	% Dead	02 Area	02 #Infl	Notes
10206	17												
10206	56	13	9	38	92	0		13	19	16	194	3	
10206	69												
10206	70	20	15	16	236	1	poor infl	19	10	16	149	1	
10206	71	22	14	38	242	0		23	19	16	343	3	
10206	72	10	9	38	71	0		9	9	5	64	0	
10206	73	10	8	16	63	0		10	8	5	63	0	
10206	74	24	21	38	396	0		28	23	16	506	51	
10206	75	15	12	16	141	0		15	12	16	141	0	
10206	76	7	3	16	16	0		7	3	16	16	0	
10206	77	19	10	16	149	0		19	10	3	149	1	
10212	78	16	15	16	188	0		17	16	16	214	0	
10212	79	25	19	16	373	0		23	22	16	397	4	
10212	80	28	16	16	352	19	poor infl	26	18	16	368	86	
10212	82	18	11	38	156	0		16	11	16	138	28	
10212	83	46	37	38	1337	0		44	38	16	1313	12	
10212	84	14	10	38	110	0	DON'T USE FOR ANALYSIS	15	8	38	94	3	DON'T USE FOR ANALYSIS
10212	85	29	16	16	364	0		33	13	16	337	7	
10401	1	47	41	38	1513	53		46	39	16	1409	42	
10401	3	13	11	16	112	0		15	12	16	141	0	
10416	4	39	31	3	950	16		44	38	1	1313	135	
11403	5	45	8	88	283	0		16	10	88	126	0	
11403	6	34	28	38	748	0		32	30	16	754	34	
11403	7	30	22	38	518	7	very poor infl	29	23	38	524	18	
11403	8	25	20	38	393	0		25	21	38	412	1	
11403	9	23	17	16	307	4	poor infl	22	17	16	294	3	
11403	10	9	4	88	28	0		9	4	88	28	2	
11403	11	32	23	38	578	7	very poor infl	32	24	38	603	29	
11403	195												
11407	12	28	16	16	352	3		31	17	16	414	36	
11407	13												
11407	14	22	19	16	328	0		22	21	16	363	8	
11407	15												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2003						2004					
		Length	Width	% Dead	03 Area	03 #infl	Notes	Length	Width	% Dead	04 Area	04 #Infl	Notes
10206	17												
10206	56	15	11	16	130	1		14	7	38	77	0	
10206	69												
10206	70	18	13	16	184	14		27	14	38	297	7	
10206	71	17	19	38	254	14		20	15	38	236	8	
10206	72	11	9	16	78	0		11	10	38	86	0	
10206	73	11	8	16	69	1		9	8	38	57	0	
10206	74	29	24	16	547	31		29	26	38	592	6	
10206	75	15	13	16	153	0		16	13	38	163	0	
10206	76	7	3	38	16	0							
10206	77	21	10	16	165	5		18	13	88	184	0	
10212	78	19	14	16	209	35		20	16	16	251	0	
10212	79	28	24	16	528	49		27	24	5	509	18	
10212	80	28	19	16	418	93		32	18	38	452	38	
10212	82	27	15	3	318	16		35	23	3	632	13	
10212	83	49	41	3	1578	36		50	41	38	1610	38	
10212	84						DON'T USE FOR ANALYSIS						DON'T USE FOR ANALYSIS
10212	85	34	14	16	374	17		36	16	38	452	24	
10401	1	46	33	16	1192	75		49	48	16	1847	68	
10401	3	15	12	0	141	2		14	14	3	154	0	
10416	4	40	35	1	1100	110		46	45	1	1626	112	
11403	5	8	3	88	19	0		7	4	88	22	0	
11403	6	31	34	16	828	67		37	33	16	959	33	
11403	7	32	19	16	478	32		30	19	38	448	19	
11403	8	25	23	3	452	23		28	24	38	528	4	
11403	9	24	19	16	358	26		24	18	16	339	2	
11403	10	8	8	16	50	2		10	6	38	47	0	
11403	11	23	26	16	470	41		34	26	5	694	14	tag missing
11403	195												
11407	12	32	19	16	478	13		35	20	16	550	19	
11407	13												
11407	14	26	22	16	449	11		27	22	16	467	11	
11407	15												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2005						2006					
		Length	Width	% Dead	05 Area	05 #Infl	Notes	Length	Width	% Dead	06 Area	06 #Infl	Notes
10206	17												
10206	56	14	8	63	88	0	weak.wilted	13	8	4	82	9	
10206	69												dead
10206	70	19	15	63	224	0		16	13	3	163	19	
10206	71	20	16	63	251	0		17	13	5	174	9	
10206	72	11	9	63	78	0		9	7	4	49	0	
10206	73	10	8	63	63	0		12	8	4	75	1	
10206	74	10	8	63	63	0		23	15	5	271	11	
10206	75	16	13	38	163	0		16	13	3	163	1	
10206	76							17	12	4	160	0	dead
10206	77	18	13	63	184	0		20	13	3	204	1	
10212	78	22	15	38	259	0		22	18	2	311	21	
10212	79	30	26	63	613	0		25	25	3	491	66	
10212	80	32	20	63	503	0		25	25	3	491	119	
10212	82	19	14	88	209	0	only 3 living leaves	17	8	5	107	19	
10212	83	47	40	63	1477	0	very wilted	48	27	3	1018	38	
10212	84						DON'T USE FOR ANALYSIS	14	8	5	88	13	DON'T USE FOR ANALYSIS.
10212	85	34	14	63	374	0		22	17	3	294	31	
10401	1	50	40	38	1571	9	Moved tag to 70, 0?)	51	39	3	1562	1145	
10401	3	16	12	38	151	0		18	15	3	212	1	
10416	4	45	40	16	1414	1	Tag moved to edge of plant	50	46	3	1806	253	
11403	5												
11403	6	37	33	63	959	0		38	33	4	985	32	
11403	7	33	23	63	596	0		34	19	4	507	48	
11403	8	28	25	63	550	0		29	25	4	569	32	
11403	9	24	19	38	358	0		25	19	3	373	27	
11403	10	11	9	38	78	0	Missing tag - has nail	10	9	3	71	1	
11403	11	32	27	63	679	0		35	22	3	605	49	
11403	195												
11407	12	36	19	63	537	2		38	20	3	597	52	
11407	13												dead
11407	14							28	25	3	550	4	
11407	15										0		dead

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2007						2008					
		Length	Width	% Dead	07 Area	07 #Infl	Notes	Length	Width	% Dead	08 Area	08 #Infl	Notes
10206	17	12	8	3	75	0	tag # 17 also in 13006				0		
10206	56	13	7	4	71	0		14	11	6	121	0	
10206	69						dead				0		dead
10206	70	13	11	2	112	0		16	14	3	176	0	
10206	71	16	13	4	163	0		17	15	4	200	0	
10206	72	9	4	4	28	0		10	10	4	79	0	
10206	73				0			12	9	4	85	0	
10206	74	18	16	5	226	0		19	16	5	239	0	
10206	75	16	13	3	163	0		16	13	3	163	0	
10206	76				0		dead				0		dead
10206	77	18	2	3	28	0		20	13	3	204	0	
10212	78	22	17	2	294	0		23	18	3	325	0	
10212	79	25	24	3	471	0		29	25	4	569	12	
10212	80	24	22	3	415	5		25	24	3	471	23	
10212	82	15	10	3	118	0		18	15	3	212	0	
10212	83	40	29	2	911	5		38	31	3	925	1	
10212	84				0			24	17	3	320	5	
10212	85	21	13	2	214	0					0		
10401	1	42	40	3	1319	14		51	41	3	1642	72	
10401	3	17	16	1	214	0		17	15	2	200	0	
10416	4	49	45	1	1732	37		53	45	2	1873	37	
11403	5						dead				0		
11403	6	35	32	3	880	7		40	32	6	1005	0	
11403	7	35	20	3	550	0		35	20	3	550	3	
11403	8	32	25	3	628	0		30	26	3	613	0	
11403	9	25	20	5	393	3		26	19	3	388	0	
11403	10	10	9	2	71	4		9	5	2	35	0	
11403	11	30	21	3	495	2		27	20	3	424	0	
11403	195												
11407	12	40	20	3	628	11		40	17	4	534	13	
11407	13										0		dead
11407	14	29	24	3	547	0		24	24	3	452	0	
11407	15				0						0		dead

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2009						2010					
		Length	Width	% Dead	09 Area	09 #Infl	Notes	Length	Width	% Dead	10 Area	10 #Infl	Notes
10206	17				0						0		
10206	56	1	1	6	1	0					0		dead
10206	69				0		dead				0		dead
10206	70	14	13	3	143	0		14	14	3	154	2	
10206	71	15	15	3	177	0		16	13	3	163	2	
10206	72	8	5	4	31	0		9	7	4	49	0	
10206	73	12	9	3	85	0		5	6	5	24	0	
10206	74	14	11	5	121	0		15	10	5	118	0	
10206	75	17	14	3	187	2		18	13	3	184	1	
10206	76				0		dead				0		dead
10206	77	19	14	3	209	0		16	14	4	176	0	
10212	78	24	19	3	358	0		23	19	3	343	9	
10212	79	30	26	3	613	20		33	26	2	674	12	
10212	80	25	20	3	393	33		27	19	2	403	63	
10212	82	18	10	3	141	4		18	11	3	156	5	
10212	83	44	34	3	1175	27		49	31	3	1193	36	
10212	84				0						0		dead
10212	85	22	16	3	276	6		24	17	2	320	15	
10401	1	57	41	3	1835	62		54	42	2	1781	162	
10401	3	17	16	2	214	0		19	16	3	239	0	
10416	4	56	50	3	2199	46					0		
11403	5				0		dead				0		dead
11403	6				0		dead				0		dead
11403	7	35	21	3	577	1		37	21	3	610	24	
11403	8	29	25	3	569	2		27	27	2	573	21	
11403	9	25	20	3	393	0		26	17	3	347	11	
11403	10	11	9	3	78	0					0		dead
11403	11	35	21	3	577	2	nail but tag missing	26	15	2	306	26	nail but tag missing
11403	195												
11407	12	40	18	3	565	9		36	10	3	283	28	
11407	13				0		dead				0		dead
11407	14	28	24	3	528	0		26	26	2	531	3	
11407	15				0		plant gone no tag				0		plant gone no tag

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2011						2012						
		Length	Width	% Dead	11 Area	11 #Infl	Notes	Length	Width	% Dead class	12 Area	12 #Infl	mortality class	Notes
10206	17				0						0			
10206	56				0		dead				0		5	
10206	69				0		dead				0		6	
10206	70	16	15	2	188	1		20	13	2	204	0		
10206	71	20	17	2	267	3		16	16	2	201	0		
10206	72	10	9	4	71	0		0	0	6	0	0	3	dead
10206	73	8	7	5	44	0		0	0	6	0	0	3	dead
10206	74				0		dead	16	10	4	126	0		
10206	75	23	17	2	307	6		18	16	3	226	0		
10206	76				0		dead				0			
10206	77	17	14	4	187	0		17	7	3	93	0		
10212	78	32	28	2	704	8		25	24	2	471	0		
10212	79	29	26	2	592	43		34	28	3	748	0		
10212	80	29	26	2	592	76		29	22	3	501	0		
10212	82	21	14	2	231	13		19	12	3	179	0		
10212	83	47	37	2	1366	97		50	34	3	1335	0		
10212	84				0		dead				0	0	6	
10212	85	24	26	3	490	22		24	18	3	339	0		
10401	1	59	45	3	2085	74		56	44	3	1935	37		
10401	3	21	19	2	313	0		20	14	2	220	0		
10416	4	62	51	4	2483	142				6	0		1	
11403	5				0		dead			6	0		6	
11403	6				0		dead			6	0		5	
11403	7	41	24	3	773	43		38	24	3	716	4		
11403	8	32	30	2	754	67		31	28	2	682	0		
11403	9	31	23	3	560	2		30	21	2	495	0		
11403	10				0		dead			6	0		6	
11403	11	39	24	2	735	19	nail but tag missing	28	21	2	462	0		
11403	195	28	18	1	396	15	? Pl not prev recorded	24	18	2	339	1		
11407	12	41	17	3	547	17		39	15	3	459	5		
11407	13				0		dead				0			not found
11407	14	31	28	3	682	0		25	25	3	491	0		
11407	15				0		plant gone no tag				0			not found

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1=Top; 2=Slope	x-axis	y-axis	1997					1998				
					Length	Width	% Dead	97 Area	97 #Infl	Length	Width	% Dead	98 Area	98 #Infl
11407	16	2	140	69	10	7	1	55	5	13	10	1	102	15
11407	112	2	166	77										
11605	28	1	16	76	33	18	3	467	13	33	18	16	467	20
11605	29	1	28	63	18	15	1	212	30	18	15	3	212	6
11605	30	1	29	20	13	10	16	102	1	13	10	16	102	0
11605	31	1	20	53	17	11	1	147	20	17	11	3	147	9
11605	32	1	120	0	18	16	3	226	32	17	15	16	200	1
11605	33	1	5	39	9	6	1	42	1	9	6	3	42	0
11605	34	1	151	4	24	19	3	358	52	25	20	3	393	15
11605	35	1	-1	2	17	15	3	200	32	18	15	16	212	6
11605	36	1	30	28	8	5	16	31	0	7	5	16	27	0
11605	37	1	172	36	34	27	1	721	188	35	29	3	797	70
11611	38	2	4	27	33	26	1	674	114	31	24	3	584	5
11611	39	2	68	5	11	9	38	78	0	12	6	16	57	0
13006	17	1	4	14	12	10	16	94	11	10	10	16	79	3
13006	18	1	15	33	15	15	1	177	32	14	14	3	154	12
13006	19	1	35	90	21	21	3	346	0	22	20	16	346	0
13006	20	1	46	0	14	10	3	110	11	14	9	3	99	2
13006	21	1	66	25	27	15	16	318	26	25	13	16	255	12
13006	22	1	90	72	29	25	16	569	43	27	26	16	551	17
13006	23	1	120	80	47	41	16	1513	142	47	43	16	1587	78
13006	24	1	118	33	28	19	16	418	13	20	27	16	424	4
13006	25	1	168	20	35	27	16	742	49	36	35	16	990	70
13024	26	2	73	40	18	12	3	170	0	20	14	3	220	1
13024	27	2	103	90	43	32	88	1081	0	42	20	88	660	12
13024	192	2	124	48										
20205	103	1	0	70	25	18	1	353	37	27	20	1	424	30
20205	104	1	109	74	39	31	38	950	83	36	29	63	820	24
20205	105	1	94	55	18	15	3	212	27	18	16	16	226	0
20205	107	1	140	0	25	20	16	393	25	27	20	63	424	21

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1999					2000					Notes
		Length	Width	% Dead	99 Area	99 #Infl	Length	Width	% Dead	00 Area	00 #Infl	
11407	16	15	13	1	153	3	18	15	1	212	20	good quality, ~20recently knocked off- grazing?
11407	112	6 leaves in May, 17 in July					2.5	2	1	4	0	too many leaves to count
11605	28	35	21	16	577	6	33	18	38	467	0	
11605	29	18	13	16	184	3	24	17	38	320	0	
11605	30	13	8	16	82	0	13	10	15	102	0	
11605	31	18	11	16	156	0	17	13	38	174	0	
11605	32	19	16	38	239	1	19	17	38	254	0	
11605	33	9	7	16	49	0	9	7	63	49	0	
11605	34	26	22	16	449	2	25	20	63	393	0	
11605	35	18	15	16	212	5	18	16	38	226	0	
11605	36	7	5	3	27	0	7	4	15	22	0	
11605	37	35	29	16	797	10	33	26	38	674	1	poor infl
11611	38	33	24	16	622	16	32	24	15	603	15	
11611	39	13	5	3	51	0	14	6	3	66	0	
13006	17	10	6	38	47	0	11	9	15	78	1	poor infl
13006	18	15	13	38	153	0	15	15	38	177	4	poor infl
13006	19	23	15	63	271	0	23	20	63	361	0	
13006	20	15	12	16	141	0	15	9	15	106	3	poor infl
13006	21	25	15	16	295	3	25	15	15	295	15	poor infl
13006	22	26	26	16	531	2	26	26	15	531	30	poor infl
13006	23	51	46	16	1843	11	50	48	15	1885	71	
13006	24	30	22	16	518	0	31	23	15	560	29	
13006	25	37	37	38	1075	5	35	32	38	880	6	
13024	26	23	16	1	289	7	27	20	3	424	30	healthy infl, infl still emerging
13024	27	36	14	63	396	12						dead-attempted to leafout this year
13024	192											
20205	103	30	20	3	471	8	30	22	15	518	28	
20205	104	37	24	63	697	5	35	29	38	797	72	
20205	105	18	18	16	254	2	20	17	3	267	36	
20205	107	30	21	38	495	3	31	22	15	536	41	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2001						2002					
		Length	Width	% Dead	01 Area	01 #Infl	Notes	Length	Width	% Dead	02 Area	02 #Infl	Notes
11407	16	21	17	1	280	24	infl are good	20	18	1	283	57	
11407	112	4	4	1	13	0		6	5	1	24	0	
11605	28	29	21	38	478	0		29	20	63	456	1	
11605	29	26	18	63	368	0		26	19	38	388	32	
11605	30	14	9	63	99	0		14	10	38	110	0	
11605	31	19	12	63	179	0		16	13	38	163	6	
11605	32	19	16	63	239	0		20	19	63	298	3	
11605	33	8	8	38	50	0		9	7	16	49	0	
11605	34	27	21	38	445	0		27	20	38	424	25	
11605	35	20	17	38	267	0		21	17	38	280	0	
11605	36	7	5	63	27	0		7	4	63	22	0	
11605	37	35	29	38	797	0		36	30	38	848	21	
11611	38	33	27	16	700	0		33	28	38	726	88	
11611	39	14	6	16	66	0		15	7	16	82	1	
13006	17	12	7	16	66	1		11	7	16	60	0	
13006	18	17	16	16	214	1		16	13	16	163	0	
13006	19	24	15	38	283	0		24	16	63	302	0	
13006	20	17	11	16	147	0		17	12	16	160	5	
13006	21	28	18	16	396	1	very poor infl	29	17	16	387	5	
13006	22	27	20	38	424	17	very poor infl	28	23	38	506	26	
13006	23	54	48	16	2036	14		53	49	16	2040	20	
13006	24	33	21	38	544	15	very poor infl	33	20	38	518	4	
13006	25	39	33	16	1011	2		40	35	16	1100	4	
13024	26	30	21	1	495	22		31	24	1	584	66	
13024	27												
13024	192												
20205	103	33	24	16	622	4		34	26	16	694	17	
20205	104	36	22	38	622	17	poor infl	35	17	38	467	24	
20205	105	22	22	16	380	1	poor infl	21	18	16	297	13	
20205	107	35	18	3	495	12	very poor infl	33	24	38	622	16	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2003						2004					
		Length	Width	% Dead	03 Area	03 #infl	Notes	Length	Width	% Dead	04 Area	04 #Infl	Notes
11407	16	23	21	1	379	6		24	24	1	452	31	
11407	112	8	6	1	38	6		8	8	1	50	1	
11605	28	25	22	38	432	20		26	22	0	449	0	
11605	29	26	21	16	429	35		26	16	16	327	4	Missing tag- seemd to be at 50/50
11605	30	15	10	16	118	0		15	10	16	118	0	
11605	31	13	15	88	153	0					0		
11605	32	23	23	16	415	15		22	22	16	380	2	
11605	33	26	28	16	572	0		30	29	38	683	3	
11605	34	27	22	16	467	18		27	33	38	700	4	
11605	35	21	19	3	313	37		22	19	16	328	3	
11605	36												tag pulled
11605	37	38	28	16	836	59		50	36	38	1414	13	
11611	38	32	29	1	729	75		34	32	16	855	73	
11611	39	17	9	1	120	10		15	8	3	94	0	
13006	17	11	8	16	69	3		11	8	16	69	6	
13006	18	14	15	3	165	19	Many broken off infl	16	11	16	138	17	
13006	19	21	15	38	247	0		20	13	5	204	0	
13006	20	16	10	3	126	5		19	16	16	239	15	
13006	21	29	16	16	364	10		31	15	16	365	13	
13006	22	30	23	16	542	18	Many broken off infl	31	21	16	511	22	
13006	23	52	47	16	1920	22		56	54	38	2375	46	
13006	24	36	20	16	565	9		19	13	5	194	2	
13006	25	35	29	16	797	5		26	16	38	327	12	
13024	26	34	27	1	721	38		37	28	3	814	66	
13024	27												
13024	192												
20205	103	36	26	16	735	40		36	28	38	792	12	
20205	104	33	19	16	492	69		35	19	16	522	22	
20205	105	24	23	16	434	60		26	22	38	449	1	
20205	107	35	23	16	632	61		38	23	16	686	25	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2005						2006					
		Length	Width	% Dead	05 Area	05 #Infl	Notes	Length	Width	% Dead	06 Area	06 #Infl	Notes
11407	16	25	19	16	373	4	Needs tag. At 49, 130?	30	24	2	565	79	
11407	112	9	8	16	57	0		10	10	1	79	10	
11605	28	27	22	63	467	0		32	29	4	729	33	
11605	29	27	18	63	382	0	Tag needed? At 50,50?	30	26	3	613	29	
11605	30	15	10	63	118	0		17	9	2	120	0	
11605	31												dead
11605	32	23	23	63	415	0		26	12	4	245	23	
11605	33	33	27	63	700	0		34	32	4	855	62	
11605	34	34	26	63	694	0		29	24	3	547	27	
11605	35	20	22	63	346	0		23	21	3	379	53	
11605	36												
11605	37	34	26	63	694	0		55	32	4	1382	120	
11611	38	14	8	88	88	0		36	30	3	848	184	
11611	39	34	26	88	694	0		17	11	3	147	6	
13006	17	11	8	63	69	0		10	9	3	71	8	
13006	18	15	14	63	165	0		17	11	3	147	23	
13006	19	20	10	88	157	0							dead
13006	20	18	15	63	212	0		20	13	2	204	7	
13006	21	20	10	88	157	0		29	12	3	273	16	
13006	22	32	23	63	578	0		31	25	4	609	53	
13006	23	56	51	63	2243	1		56	51	5	2243	115	
13006	24	20	14	63	220	0		22	14	5	242	14	
13006	25	25	29	63	569	0		30	27	5	636	35	
13024	26	37	30	16	872	26		42	36	3	1188	117	
13024	27												
13024	192							3	2	1	5	0	retag in 2007
20205	103	37	27	63	785	3		35	34	4	935	35	
20205	104	36	19	63	537	7		37	22	3	639	58	
20205	105	25	22	63	432	0		26	21	4	429	11	
20205	107	38	27	63	806	5		70	39	3	2144	30	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2007						2008					
		Length	Width	% Dead	07 Area	07 #Infl	Notes	Length	Width	% Dead	08 Area	08 #Infl	Notes
11407	16	31	22	1	536	12		30	21	2	495	19	
11407	112	12	11	1	104	0		11	10	2	86	0	
11605	28	28	9	4	198	0	near by plants previously considered part of this?	37	28	4	814	0	
11605	29	29	24	3	547	0					0		
11605	30	16	10	3	126	0		16	11	4	138	0	
11605	31										0		
11605	32	24	22	3	415	0		23	21	3	379	0	
11605	33	34	33	3	881	3		35	33	4	907	0	
11605	34	32	290	3	7288	0		27	23	3	488	0	
11605	35	21	19	3	313	0		25	20	4	393	0	
11605	36										0		
11605	37	52	31	3	1266	0		41	30	3	966	0	
11611	38	33	23	2	596	6		38	31	2	925	2	
11611	39	15	9	3	106	0		18	10	4	141	0	
13006	17	11	8	3	69	0		11	9	4	78	0	
13006	18	16	11	3	138	0		20	10	2	157	4	
13006	19										0		dead
13006	20	19	12	2	179	2		22	15	2	259	5	
13006	21	30	11	3	259	0		31	12	4	292	0	
13006	22	31	23	3	560	5		27	25	2	530	29	
13006	23	54	50	3	2121	8		60	49	3	2309	49	
13006	24	22	14	3	242	0		17	12	3	160	7	
13006	25	30	29	3	683	4		35	28	4	770	15	
13024	26	40	35	1	1100	23		46	42	3	1517	76	
13024	27						dead, tag removed				0		
13024	192				0		tag 194	5	4		16		now 194
20205	103	39	29	4	888	2		35	32	3	880	0	
20205	104	38	22	3	657	9		39	23	5	705	0	
20205	105	27	22	4	467	0		28	24	4	528	0	
20205	107	38	34	3	1015	9		41	32	3	1030	43	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2009						2010					
		Length	Width	% Dead	09 Area	09 #Infl	Notes	Length	Width	% Dead	10 Area	10 #Infl	Notes
11407	16	29	25	3	569	35	tag not visible	29	23	2	524	41	tag not visible
11407	112	12	11	2	104	5		13	12	2	123	16	
11605	28	21	28	6	462	0		7	7	6	38	4	
11605	29				0						0		no tag no plant
11605	30	16	10	4	126	0		15	8	5	94	0	
11605	31				0						0		dead, no tag
11605	32	23	21	4	379	0	mostly out of plot	20	16	3	251	13	mostly out of plot
11605	33	38	33	4	985	2		36	30	4	848	26	
11605	34	28	22	4	484	0		28	22	4	484	6	
11605	35	22	19	3	328	7		22	21	3	363	12	
11605	36				0						0		no plant
11605	37	41	32	4	1030	0		41	32	3	1030	103	
11611	38	38	34	3	1015	89		35	27	2	742	146	
11611	39	17	11	3	147	0		19	13	3	194	2	
13006	17	9	7	3	49	0		10	9	2	71	3	
13006	18	16	11	3	138	1		14	13	3	143	15	
13006	19				0		dead				0		dead
13006	20	20	13	2	204	7		20	17	2	267	5	
13006	21	30	11	4	259	0					0		dead
13006	22	30	25	3	589	8		30	23	2	542	58	
13006	23	58	53	3	2414	28		58	47	2	2141	67	
13006	24	15	11	3	130	3		23	16	2	289	24	
13006	25	32	25	3	628	1		25	19	4	373	24	
13024	26	49	40	3	1539	121		45	41	3	1449	220	
13024	27				0						0		dead
13024	192	5	4	1	16	0	now 194	7	6	2	33	2	now 194
20205	103	39	30	3	919	8		43	31	1	1047	36	
20205	104	37	23	6	668	0					0		dead
20205	105	27	24	3	509	0		28	21	2	462	29	
20205	107	43	34	3	1148	38	dying where x axis lies on plant	42	41	2	1352	88	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2011						2012						
		Length	Width	% Dead	11 Area	11 #Infl	Notes	Length	Width	% Dead class	12 Area	12 #Infl	mortality class	Notes
11407	16	31	22	2	536	63	tag not visible	35	24	2	660	40		
11407	112	17	16	1	214	7		16	14	2	176	8		
11605	28	10	12	6	94	0		10	8	5	63	0		
11605	29	39	31	2	950	35	no tag no plant in 2010	29	18	3	410	0		
11605	30	17	10	3	134	0		16	7	5	88	0		
11605	31				0		dead, no tag				0			no plant or tag found
11605	32	28	22	3	484	26	mostly out of plot	27	21	3	445	0		
11605	33	41	28	4	902	21		38	35	4	1045	0		
11605	34	28	26	3	572	0		35	28	5	770	0		
11605	35	26	27	3	551	11		24	23	3	434	0		
11605	36				0		no plant				0			no plant
11605	37	40	27	2	848	3		41	32	4	1030	0		
11611	38	42	37	2	1221	128		41	35	2	1127	0		
11611	39	22	14	4	242	3		21	12	5	198	0		
13006	17	12	8	1	75	16		11	11	2	95	0		
13006	18	16	10	1	126	30		16	12	2	151	3		
13006	19				0		dead				0		5	pulled tag
13006	20				0			22	20	2	346	3		
13006	21				0		dead				0		5	
13006	22	32	27	2	679	44		34	27	3	721	2		
13006	23	57	56	3	2507	139		60	56	3	2639	11		
13006	24	25	13	2	255	24		20	14	2	220	0		
13006	25	34	16	4	427	17		33	23	4	596	5		
13024	26	48	46	3	1734	157		50	46	3	1806	10		
13024	27				0		dead				0			no plant
13024	192	10	10	1	79	2	now 194	9	7	2	49	0		now 194
20205	103	43	23	2	777	64	tagged now as 99	38	24	3	716	10		Now 99
20205	104				0		dead			3	0			
20205	105	28	17	2	374	46		29	25	3	569	4		
20205	107	53	30	1	1249	100	dying where x axis lies on plant	44	37	3	1279	32		

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1=Top; 2=Slope	x-axis	y-axis	1997					1998				
					Length	Width	% Dead	97 Area	97 #Infl	Length	Width	% Dead	98 Area	98 #Infl
20205	108	1	112	0	18	12	16	170	0	19	13	38	194	0
20205	111	1	67	70	2	2	1	3	0	2.5	2	1	4	0
20205	106	1	3	62	18	13	3	184	1	18	16	16	226	4
20601	40	1	9	4	14	9	16	99	11	14	9	16	99	3
20601	41	1	91	53	17	12	3	160	4	16	14	16	176	0
20601	42	1	29	40	15	10	38	118	5	11	8	38	69	0
20601	43	1	110	25	12	11	3	104	0	12	11	3	104	0
20601	44	1	124	60	25	13	63	255	17	14	11	63	121	0
20601	45	1	168	48	16	13	38	163	1	18	14	38	198	0
20601	46	1	72	49	20	14	5	220	0	20	14	4	220	7
20601	47	1	29	31	7	6	16	33	0	7	6	16	33	0
20601	48	1	165	15	47	34	16	1255	38	47	35	16	1292	65
20601	49	1	36	22	15	12	16	141	3	14	11	16	121	0
20607	51	2	96	54	20	16	3	251	23	21	17	3	280	55
23004	86	1	84	73	34	30	3	801	78	37	28	16	814	50
23008	87	2	101	0	49	39	16	1501	48	49	41	63	1578	28
23008	88	2	84	24	25	24	38	471	2	28	21	63	462	12
23408	50	2	15	30	40	30	3	942	209	38	34	3	1015	215
23408	52	2	30/56	0/33	30	22	63	518	54	34	24	63	641	44
23408	53	2	58	80	19	17	3	254	32	21	21	3	346	73
23408	54	2	112	53	18	12	3	170	6	19	12	16	179	17
23408	55	2	192	80	11	8	16	69	5	12	8	16	75	8
23804	57	1	75	0	15	13	3	153	0	16	15	16	188	10
23804	58	1	25	12	18	17	1	240	5	20	20	16	314	14
23804	59	1	39	42	21	12	3	198	0	23	13	16	235	5
23804	60	1	110	0	40	35	1	1100	123	44	42	16	1451	65
23804	61	1	144	90	14	12	16	132	0	14	14	38	154	0
23804	62	1	181	27	13	10	16	102	2	14	10	16	110	12
23804	63	1	182	0	25	23	63	452	29	25	23	88	452	28
23804	64	1	71	60	25	17	16	334	48	23	17	16	307	13
23804	65	1	69	96	10	7	16	55	0	10	6	63	47	0

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1999					2000					
		Length	Width	% Dead	99 Area	99 #Infl	Length	Width	% Dead	00 Area	00 #Infl	Notes
20205	108	18	13	38	184	0	19	11	15	164	3	poor infl
20205	111	3	2.5	1	6	0	4	4	1	13	0	
20205	106	19	17	16	254	1	18	15	15	212	2	
20601	40	14	12	38	132	0	14	9	15	99	1	
20601	41	17	17	38	227	8	17	16	15	214	0	
20601	42	16	13	38	163	0	11	8	63	69	0	
20601	43	14	11	3	121	0	12	14	15	132	0	
20601	44											
20601	45	19	16	38	239	0	20	14	38	220	0	
20601	46	20	14	38	220	0	22	15	3	259	8	small infl
20601	47	8	7	63	44	0	7	7	38	38	0	
20601	48	48	39	16	1470	30	49	39	15	1501	89	infl poor
20601	49	15	12	38	141	1	12	12	38	113	1	looks stressed, infl poor
20607	51	25	22	3	432	30	26	22	1	449	75	
23004	86	37	29	16	843	3	37	27	15	785	16	infl sessile
23008	87	49	42	38	1616	8	48	41	38	1546	24	poor infl
23008	88	29	21	16	478	1	26	20	15	408	6	
23408	50	39	35	16	1072	42	39	39	38	1195	108	50% poor infl
23408	52											
23408	53	23	21	3	379	3	24	21	3	396	39	infl finished
23408	54	19	12	3	179	0	20	13	15	204	17	
23408	55	14	9	16	99	0	13	12	15	123	2	
23804	57	18	15	16	212	0	16	16	15	201	1	poor infl
23804	58	21	21	38	346	1	21	21	15	346	2	infl finished
23804	59	23	14	16	253	0	23	13	38	235	0	
23804	60	44	41	38	1417	2	44	32	38	1106	3	poor infl
23804	61	15	13	3	153	0	16	12	15	151	0	
23804	62	15	11	3	130	0	14	11	15	121	4	
23804	63											
23804	64	21	20	63	330	0	23	17	38	307	0	
23804	65											

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2001							2002					
		Length	Width	% Dead	01 Area	01 #Infl	Notes	Length	Width	% Dead	02 Area	02 #Infl	Notes
20205	108												
20205	111	6	5	1	24	0		5	5	1	20	0	
20205	106	21	19	16	313	0		21	21	16	346	7	
20601	40	16	10	38	126	0		18	10	16	141	4	
20601	41	18	14	16	198	1	poor infl	19	14	38	209	0	
20601	42	17	10	38	134	0		18	20	38	283	1	
20601	43	15	14	38	165	0		15	13	38	153	0	
20601	44												
20601	45	19	10	16	149	1	poor infl	20	10	16	157	1	
20601	46	22	15	38	259	0	split from 2 plants, both called 46	21	14	38	231	2	
20601	47	9	6	38	42	0		8	8	38	50	0	
20601	48	51	39	16	1562	33		53	40	16	1665	81	
20601	49	14	11	38	121	0		14	13	38	143	2	
20607	51	29	26	1	592	62		27	25	1	530	67	
23004	86	37	28	16	814	0		37	29	16	843	51	
23008	87	45	43	38	1520	5	very poor infl	46	44	38	1590	44	
23008	88	30	22	38	518	1	poor infl	33	23	16	596	25	
23408	50	31	21	88	511	26	very poor infl						
23408	52												
23408	53	27	24	16	509	34		28	24	3	528	66	
23408	54	21	13	3	214	1		22	14	16	242	13	
23408	55	15	13	3	153	1		17	11	3	147	4	
23804	57	20	19	16	298	0		21	17	16	280	8	
23804	58	23	23	38	415	1	poor infl	25	23	16	452	3	
23804	59	29	14	38	319	0		24	14	38	264	1	
23804	60	20	19	16	298	0		47	44	38	1624	12	
23804	61	47	45	38	1661	0		18	14	16	198	10	
23804	62	17	14	16	187	0		17	15	38	200	14	
23804	63												
23804	64	23	13	88	235	0		23	11	63	199	2	
23804	65												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2003						2004					
		Length	Width	% Dead	03 Area	03 #infl	Notes	Length	Width	% Dead	04 Area	04 #Infl	Notes
20205	108												
20205	111	8	7	1	44	0		9	7	1	49	0	
20205	106	23	21	16	379	16		24	23	38	434	1	
20601	40	18	9	3	127	4		19	10	3	149	4	
20601	41	19	18	16	269	7		22	16	16	276	3	
20601	42	19	9	16	134	3		18	11	16	156	5	
20601	43	17	14	38	187	0		18	14	38	198	0	
20601	44												
20601	45	19	11	16	164	9		21	12	16	198	0	
20601	46	21	15	38	247	6		19	15	16	224	7	
20601	47	9	7	0	49	3		9	7	38	49	0	
20601	48	53	42	16	1748	126		51	38	38	1522	18	
20601	49	14	13	16	143	3		46	18	16	650	12	
20607	51	32	28	3	704	57		33	30	3	778	29	
23004	86	39	33	16	1011	77		41	34	3	1095	119	
23008	87	45	43	38	1520	29		46	44	16	1590	32	
23008	88	33	25	16	648	24		34	23	38	614	5	
23408	50												
23408	52												
23408	53	30	25	3	589	93		31	30	16	730	45	
23408	54	22	15	16	259	8		23	14	16	253	4	
23408	55	18	12	16	170	12		18	13	3	184	4	
23804	57	22	18	16	311	4		23	20	16	361	5	
23804	58	28	27	16	594	36		31	28	38	682	5	
23804	59	25	16	38	314	1		26	17	16	347	1	
23804	60	45	40	16	1414	89		48	42	38	1583	65	
23804	61	21	17	3	280	30		22	19	16	328	11	
23804	62	18	14	16	198	53		18	15	16	212	2	
23804	63												
23804	64	24	18	63	339	3		24	17	16	320	4	
23804	65												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2005						2006					
		Length	Width	% Dead	05 Area	05 #Infl	Notes	Length	Width	% Dead	06 Area	06 #Infl	Notes
20205	108												tag missing, no data recorded
20205	111	8	7	63	44	0							
20205	106	26	22	63	449	1		26	24	4	490	24	retag in 2007
20601	40	18	10	63	141	0		18	11	2	156	14	
20601	41	21	16	63	264	0		22	18	3	311	12	
20601	42	18	10	63	141	1		14	12	2	132	11	
20601	43	17	14	63	187	0		17	15	3	200	0	
20601	44												dead
20601	45	20	18	63	283	0		18	16	3	226	6	
20601	46	20	16	63	251	0		21	11	5	181	3	
20601	47	8	7	88	44	0		7	5	5	27	0	
20601	48	53	36	38	1499	20	Tough plant to define boundaries	56	53	4	2331	93	
20601	49	47	19	63	701	0		47	19	3	701	39	
20607	51	34	32	38	855	7		36	34	2	961	80	
23004	86	40	34	63	1068	0		43	39	3	1317	194	
23008	87	46	43	38	1554	7		44	36	5	1244	72	
23008	88	33	24	63	622	2		34	28	4	748	26	
23408	50												
23408	52												
23408	53	34	29	38	774	4		34	31	3	828	89	
23408	54	23	15	63	271	6		24	15	3	283	19	
23408	55	18	14	38	198	0		21	15	2	247	31	
23804	57	23	19	63	343	0		21	16	3	264	23	
23804	58	29	28	63	638	0		31	29	3	706	58	
23804	59	26	17	63	347	0		26	18	3	368	3	
23804	60	48	39	88	1470	0	lots of die-back	49	27	5	1039	91	
23804	61	22	18	63	311	0		24	17	3	320	28	
23804	62	19	15	63	224	0		20	16	4	251	21	
23804	63												dead
23804	64	24	17	63	320	0		22	14	4	242	21	
23804	65												dead

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2007						2008					
		Length	Width	% Dead	07 Area	07 #Infl	Notes	Length	Width	% Dead	08 Area	08 #Infl	Notes
20205	108										0		
20205	111	10	7	2	55	0		13	8	3	82	0	
20205	106	25	25	4	491	2	now tag 114	27	18	5	382	0	now 114
20601	40	18	13	2	184	2		22	15	3	259	5	
20601	41	22	20	3	346	1		24	20	3	377	2	
20601	42	17	12	3	160	4		19	15	4	224	3	
20601	43	20	17	2	267	0		22	16	3	276	0	
20601	44										0		dead
20601	45	18	17	3	240	0		22	15	3	259	12	
20601	46	19	13	3	194	0		21	14	3	231	0	
20601	47	8	4	2	25	0		8	7	5	44	0	
20601	48	59	53	4	2456	25		45	37	3	1308	57	
20601	49	16	15	2	188	5		19	18	3	269	2	
20607	51	38	33	1	985	109		41	39	0	1256	140	
23004	86	44	39	4	1348	3		43	41	2	1385	11	
23008	87	45	44	3	1555	10		47	45	3	1661	31	
23008	88	34	28	3	748	2		37	25	3	726	10	
23408	50						dead				0		dead
23408	52						dead				0		dead
23408	53	34	31	3	828	2		38	34	1	1015	16	
23408	54	23	16	3	289	0		26	17	3	347	0	
23408	55	19	14	2	209	3		24	18	2	339	0	
23804	57	25	19	3	373	2		29	24	3	547	0	
23804	58	32	28	3	704	1		34	32	3	855	6	
23804	59	18	12	3	170	0		22	14	3	242	0	
23804	60	51	25	4	1001	2		55	47	4	2030	0	
23804	61	20	20	2	314	3		25	21	2	412	0	
23804	62	18	14	3	198	1		22	18	3	311	0	
23804	63										0		dead
23804	64	24	20	3	377	2		24	23	2	434	0	2 plants?
23804	65										0		no tag

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2009						2010					
		Length	Width	% Dead	09 Area	09 #Infl	Notes	Length	Width	% Dead	10 Area	10 #Infl	Notes
20205	108				0						0		
20205	111	11	7	3	60	0		11	8	1	69	0	
20205	106	125	125	5	12272	4	now 114				0		now 114, dead
20601	40	19	14	3	209	7		20	14	3	220	19	
20601	41	26	20	3	408	0		26	21	2	429	1	
20601	42	18	14	3	198	1		18	14	2	198	2	
20601	43	16	16	3	201	0		20	15	3	236	0	
20601	44				0		dead				0		dead
20601	45	19	17	3	254	0		21	20	2	330	1	
20601	46	20	13	4	204	0		17	15	6	200	0	
20601	47	8	5	6	31	0	dead but data?				0		dead but data?
20601	48	45	37	3	1308	35	damage by pvc	45	43	3	1520	160	damage by pvc
20601	49	19	17	3	254	0		19	19	2	284	9	
20607	51	40	36	2	1131	114	plant grown over tag	43	36	2	1216	170	plant grown over tag
23004	86	45	42	3	1484	23		47	41	2	1513	185	
23008	87	48	44	4	1659	45		48	34	3	1282	89	
23008	88	36	23	4	650	19		35	24	3	660	48	
23408	50				0						0		dead
23408	52				0						0		dead
23408	53	36	31	3	877	30	no tag	38	36	2	1074	76	no tag
23408	54	24	15	3	283	10		25	15	3	295	9	
23408	55	21	17	4	280	2		22	17	2	294	14	
23804	57	25	18	4	353	8		27	19	3	403	2	
23804	58	22	10	3	173	11		33	29	3	752	35	
23804	59	21	13	4	214	2		23	19	3	343	0	
23804	60	49	39	5	1501	17		49	30	4	1155	14	
23804	61				0			24	20	3	377	11	
23804	62	21	17	4	280	5		21	16	4	264	2	
23804	63				0		dead				0		dead
23804	64	24	13	4	245	0		25	14	3	275	1	
23804	65				0		dead?				0		dead

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2011						2012						
		Length	Width	% Dead	11 Area	11 #Infl	Notes	Length	Width	% Dead class	12 Area	12 #Infl	mortality class	Notes
20205	108				0					5	0			
20205	111	13	9	2	92	2		14	10	2	110	0		
20205	106				0		now 114, dead				0		3	Now 114
20601	40	24	18	2	339	32		18	15	3	212	0		
20601	41	31	14	2	341	19		18	18	2	254	4		
20601	42	20	14	2	220	22		19	4	3	60	1		
20601	43	20	14	2	220	0		18	17	3	240	0		
20601	44				0		dead				0		4	dead
20601	45	22	20	2	346	5		20	19	3	298	1		
20601	46				0		dead				0		3	dead
20601	47				0		dead but data?				0		4	dead
20601	48	59	34	3	1576	66	damage by pvc	57	54	3	2417	86		POSE in middle of plant made it look like 2 individuals
20601	49	18	15	2	212	8		19	18	2	269	1		
20607	51	42	35	6	1155	3	plant grown over tag				0		2	
23004	86	47	39	2	1440	135		45	42	2	1484	0		
23008	87	47	36	3	1329	65		48	31	4	1169	13		
23008	88	41	24	4	773	23		28	25	4	550	0		
23408	50				0		dead				0		4	dead
23408	52				0		dead				0			
23408	53	38	36	3	1074	125	no tag	40	38	3	1194	6		no tag
23408	54	25	15	3	295	10		25	20	3	393	1		
23408	55	23	20	3	361	24		22	18	3	311	0		
23804	57	27	20	4	424	5		24	18	3	339	0		
23804	58	38	37	3	1104	75		35	34	4	935	2		
23804	59	27	15	5	318	0		21	17	4	280	0		
23804	60	48	30	4	1131	21		49	28	5	1078	2		
23804	61	26	21	3	429	18		23	21	3	379	0		
23804	62	20	14	4	220	4		20	15	4	236	0		
23804	63				0		dead				0		5	dead
23804	64	24	18	3	339	3		24	15	4	283	3		
23804	65				0		dead				0		6	dead

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1=Top; 2=Slope	x-axis	y-axis	1997					1998				
					Length	Width	% Dead	97 Area	97 #Infl	Length	Width	% Dead	98 Area	98 #Infl
23810	67	2	179/47	19/17	47	17	3	628	69	47	17	3	628	189
30408	95	1	2	66	43	27	3	912	19	48	33	16	1244	26
30408	109	1	197	6	4	3	1	9	0	4	3	1	9	0
31813	96	2	156	52	50	46	16	1806	67	56	56	16	2463	105
33007	89	1	43	69	25	22	38	432	5	27	23	16	488	50
33007	90	1	37	42	23	15	16	271	0	22	17	16	294	8
33007	91	1	105	8	70	68	5	3738	35	70	68	38	3738	160
33007	91a													
33007	91b													
33007	91c													
33007	91d													
33408	97	1	28	48	39	31	16	950	15	40	34	38	1068	45
33408	98	1	0	75	10	9	1	71	1	10	9	3	71	0
33408	99	1	114	26	44	31	63	1071	14	46	27	38	975	56
33408	99b													
33408	100	1	141	21	38	37	3	1104	9	44	39	3	1348	77
33408	101	1	71	25	53	45	3	1873	36	58	46	16	2095	142
33408	47													
33411	102	2	79	17	28	22	3	484	62	30	23	3	542	51
34206	93	1	32	16	26	18	38	368	0	27	20	38	424	17
34206	94	1	52	10	36	23	63	650	0	40	24	63	754	4

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	1999					2000					
		Length	Width	% Dead	99 Area	99 #Infl	Length	Width	% Dead	00 Area	00 #Infl	Notes
23810	67	51	21	3	841	61	55	23	3	994	296	66 and 68 merged w/ 67
30408	95	47	34	16	1255	12	48	31	3	1169	99	
30408	109	4	4	1	13	0	4	4	1	13	5	
31813	96	57	54	16	2417	14	60	46	15	2168	100	some aborted
33007	89	18	8	63	113	0	22	16	38	276	13	poor infl
33007	90	22	15	38	259	0	24	14	15	264	0	
33007	91	74	68	16	3952	0	80	67	63	4210	40	poor infl
33007	91a											
33007	91b											
33007	91c											
33007	91d											
33408	97	39	34	16	1041	10	39	35	3	1072	55	poor infl
33408	98	10	10	3	79	0	11	10	3	86	0	
33408	99	45	23	16	813	17	45	29	38	1025	43	poor infl, done flowering
33408	99b											
33408	100	45	44	16	1555	24	39	33	15	1011	17	done flowering
33408	101	60	43	16	2026	31	59	47	15	2178	103	"poor-good infl"
33408	47											
33411	102	33	27	16	700	20	34	28	3	748	104	vigorous
34206	93	29	26	16	592	1	30	22	38	518	25	
34206	94	36	24	63	679	0	38	25	88	746	0	

Eriogonum codium compiled data (through 2012)

| plot # | Plant No. | 2001 | | | | | | 2002 | | | | | |
		Length	Width	% Dead	01 Area	01 #Infl	Notes	Length	Width	% Dead	02 Area	02 #Infl	Notes
23810	67	56	23	16	1012	168		56	24	16	1056	147	
30408	95	52	32	3	1307	202		53	33	3	1374	1	
30408	109	7	6	1	33	2	very poor infl	8	7	1	44	7	
31813	96	64	56	16	2815	51	half infl are poor	66	56	16	2903	195	
33007	89	20	16	38	251	2	very poor infl	21	17	16	280	31	
33007	90	23	13	38	235	0		24	14	3	264	6	
33007	91	79	69	38	4281	1		79	69	38	4281	195	
33007	91a												
33007	91b												
33007	91c												
33007	91d												
33408	97	41	38	38	1224	31	very poor infl	42	37	16	1221	97	
33408	98	13	12	16	123	0		12	12	16	113	0	
33408	99	47	21	16	775	8	very poor infl	47	23	16	849	117	
33408	99b												
33408	100	47	42	38	1550	3	small	48	47	38	1772	70	
33408	101	63	53	38	2622	1	small	63	53	3	2622	168	
33408	47												
33411	102	39	29	3	888	84		40	30	3	942	161	
34206	93	32	23	38	578	2		31	27	16	657	6	
34206	94	38	24	63	716	0		38	21	63	627	0	

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2003						2004					
		Length	Width	% Dead	03 Area	03 #infl	Notes	Length	Width	% Dead	04 Area	04 #Infl	Notes
23810	67	60	25	16	1178	267	most infl naked stalks (poor production)	60	25	16	1178	115	clearly 2 plants- these measurements for tagged plant
30408	95	52	34	3	1389	17		51	34	3	1362	24	
30408	109	9	7	1	49	2		13	12	1	123	9	
31813	96	65	55	16	2808	33		66	56	16	2903	68	
33007	89	22	19	16	328	22		22	17	3	294	52	
33007	90	27	16	3	339	10		27	16	3	339	5	
33007	91	76	68	38	4059	124	Most infl aborted (poor production)	78	63	38	3859	73	
33007	91a												
33007	91b												
33007	91c												
33007	91d												
33408	97	43	37	16	1250	54		42	37	38	1221	51	
33408	98	12	11	16	104	0		12	11	38	104	0	
33408	99	57	28	16	1253	25		52	33	38	1348	47	
33408	99b												
33408	100	49	34	38	1308	15		49	22	38	847	17	
33408	101	49	30	16	1155	36							
33408	47												
33411	102	38	31	16	925	80		37	31	16	901	59	
34206	93	32	28	16	704	6		33	29	16	752	12	
34206	94												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2005						2006					
		Length	Width	% Dead	05 Area	05 #Infl	Notes	Length	Width	% Dead	06 Area	06 #Infl	Notes
23810	67	59	26	38	1205	49	tag missing	62	23	3	1120	338	plot tag appears to be at 9 rather than 10
30408	95	54	36	16	1527	34		55	34	3	1469	109	
30408	109	14	12	3	132	2		18	15	2	212	27	Class 5 dead plant in this plot
31813	96	69	53	63	2872	19		71	58	4	3234	142	
33007	89	24	19	38	358	0		25	18	2	353	80	
33007	90	28	14	38	308	0		29	16	2	364	46	
33007	91	78	68	63	4166	15	flowers very small	82	46	5	2963	237	
33007	91a												
33007	91b												
33007	91c												
33007	91d												
33408	97				0								
33408	98	15	11	38	130	0		15	4	3	47	0	
33408	99	51	33	63	1322	5		55	33	4	1425	92	
33408	99b												
33408	100	53	27	38	1124	16		51	29	4	1162	34	
33408	101												
33408	47												
33411	102	41	33		1063	91		42	35	3	1155	170	
34206	93	32	30	38	754	3		34	31	2	828	13	
34206	94												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2007						2008					
		Length	Width	% Dead	07 Area	07 #Infl	Notes	Length	Width	% Dead	08 Area	08 #Infl	Notes
23810	67	62	25	4	1217	25		67	31	4	1631	299	
30408	95	58	35	2	1594	17		62	42	2	2045	80	
30408	109	18	15	2	212	2		25	18	2	353	36	
31813	96	73	59	5	3383	27		72	72	6	4072	0	mort. Class 3 recorded
33007	89	25	18	3	353	1		26	22	2	449	28	
33007	90	32	17	3	427	5		29	25	2	569	6	
33007	91	83	41	3	2673	36		85	71	4	4740	4	
33007	91a												
33007	91b												
33007	91c												
33007	91d												
33408	97						dead	39	38	6	1164	0	mort class 3 recorded
33408	98	15	14	1	165	0		17	15	2	200	0	
33408	99	55	35	3	1512	48		37	34	3	988	84	
33408	99b												
33408	100	53	30	3	1249	22		24	18	3	339	14	
33408	101							55	45	3	1944	44	
33408	47												
33411	102	44	35	3	1210	30	tag # not on data sheet	49	41	3	1578	119	
34206	93	35	30	3	825	4		36	32	3	905	2	
34206	94												

Eriogonum codium compiled data (through 2012)

| plot # | Plant No. | 2009 | | | | | | 2010 | | | | | |
		Length	Width	% Dead	09 Area	09 #Infl	Notes	Length	Width	% Dead	10 Area	10 #Infl	Notes
23810	67	65	32	4	1634	221		67	33	3	1737	365	
30408	95	62	40	3	1948	93		60	40	2	1885	273	
30408	109	22	18	1	311	31		25	20	1	393	50	
31813	96	72	68	6	3845	7		21	18	6	297	27	plant not correctly measured in 2009
33007	89	25	21	1	412	10		27	18	3	382	142	
33007	90	32	19	1	478	8		30	18	1	424	37	
33007	91	82	73	5	4701	26	tag 200 outside				0		tag 200 outside. 4 sub-areas measured in 2010
33007	91a							35	27	2	742	119	
33007	91b							22	16	2	276	56	
33007	91c							29	17	5	387	76	
33007	91d							22	22	2	380	54	
33408	97				0		dead				0		dead
33408	98	15	13	1	153	0		16	13	1	163	0	
33408	99	56	38	2	1671	124		36	23	1	650	127	additional part measured separately in 2010
33408	99b							34	14	3	374	65	previously part of 99
33408	100	51	29	2	1162	16		54	29	2	1230	167	
33408	101	52	30	4	1225	38		54	29	4	1230	191	
33408	47							19	19	1	284	105	new? May have previously been recorded as part of 99
33411	102	45	42	2	1484	104		49	39	2	1501	284	
34206	93	38	32	3	955	15		39	34	2	1041	46	
34206	94												

Eriogonum codium compiled data (through 2012)

plot #	Plant No.	2011						2012						
		Length	Width	% Dead	11 Area	11 #Infl	Notes	Length	Width	% Dead class	12 Area	12 #Infl	mortality class	Notes
23810	67	70	34	4	1869	398		71	36	4	2007	155		
30408	95	64	43	3	2161	100		60	43	3	2026	92		
30408	109	25	23	1	452	45		25	20	2	393	46		
31813	96				0		plant not correctly measured in 2009. Dead in 2011				0			dead
33007	89				0		dead				0			dead
33007	90	29	19		433	33		29	28	1	638	0		
33007	91				0		tag 200 outside. 4 sub-areas measured in 2010				0			
33007	91a	37	26	4	756	94		22	15	2	259	13		
33007	91b	24	16	3	302	47		28	17	2	374	2		
33007	91c	27	18	2	382	16		38	22	2	657	4		
33007	91d	20	21	3	330	28		30	18	2	424	1		
33408	97				0		dead				0			dead
33408	98	17	14	1	187	3		20	15	1	236	1		
33408	99	31	27	3	657	10	additional part measured separately in 2010	40	38	2	1194	16		recorded as 2 plants in 2010
33408	99b				0		previously part of 99				0			
33408	100	54	30		1272	83		54	30	2	1272	53		2 plants? Measuered as 1 in 2010 & 2012
33408	101	50	53		2081	203		55	45	2	1944	44		
33408	47	19	19	4	284	14	new? May have previously been recorded as part of 99 Now tagged as 47	20	15	3	236	3		
33411	102	47	43	6	1587	166		48	40	2	1508	49		
34206	93	37	36	5	1046	18		38	32	2	955	1		
34206	94													

Seedlings Data, compiled through 2012

plot #	Plant No.	x-axis	y-axis	Cohort	seedlings only	
					Near Adult (#)	Near Adt (cm)
11605	S1			96	37	0
20205	S2	69	86	96	outside plant	10
20205	S3	74	66	96	105	23
20205	S4	136	56	96	104	4
10206	S5	176	86	97	unnumb	1
10206	S6	62	86	97	69	4
11403	S7	101	27	97	9	3
11403	S8	113	24	97	9	2
11403	S9	108	48	97	8	2
11403	S10	133	44	97	11	0
11403	S11	169	0	97	11	0
11403	S12	169	0	97	11	0
11403	S13	169	0	97	11	0
11403	S14	169	0	97	11	0
11403	S15	169	0	97	11	0
11403	S16	169	0	97	11	0
11403	S17	169	0	97	11	0
11403	S18	169	0	97	11	0
11403	S19	169	0	97	11	0
13006	S20			97	21	0
13006	S21			97	20	0
13006	S22			97	24	0
13006	S23			97	24	0
13006	S24			97	24	0
13006	S25			97	24	0
13006	S26			97	24	1
13006	S27			97	25	1
20205	S28	18	42	97	106	13
20601	S29			97	48	1
23810	S30			97	67	0.5
11403	S31	133	255	98		0
11605	S32			98		
20205	S33	185	10	98		n.r.
11407	S34	166	77	99		
10516	S35	55	73	99		n.r
10516	S36	55	73	99		
23408	S37	55	87	99		
23408	S38	57	70	99		
23408	S39	58	70	99		
23408	S40	60	70	99		
23408	S41	61	69	99		
23408	S42	68	69	99		
23408	S43	70	69	99		
23408	S44	74	77	99		
23408	S45	61	67	99		
23408	S46	63	65	99		
23408	S47	62	65	99		
23408	S48	60	63	99		
23408	S49	57	66	99		
23408	S50	57	68	99		
23408	S51	55	75	99		
23408	S52	73	63	99		
23408	S53	73	62	99		

10416	S54	75	23	2000	4	27
10416	S55	66	49	2000	4	2
10416	S56	45	78	2000	4	4
10416	S57	83	85	2000	4	14
10416	S58	83	84	2000	4	13
10416	S59	25	13	2000		36
10416	S60	81	78	2000	4	11
11403	S61	161	95	2000	8	69
11403	S62	55	1	2000	7	1
11605	S63	35	11	2000	30	3.5
11611	S64	17	52	2000	38	1
11611	S65	55	33	2000	38	4
13006	S66	142	36	2000	23	0
13006	S67	156	35	2000	23	0
13006	S68	145	54	2000	23	0
13006	S69	135	21	2000	23	0
13006	S70	137	47	2000	23	0
13006	S71	151	35	2000	23	0
13006	S72	9	50	2000	18	18
20205	S73	8	52	2000	106	0.5
20601	S74	188	60	2000	48	2
20601	S75	173	11	2000	48	7
20601	S76	170	50	2000	48	0.5
20607	S77	109	65	2000	51	0.5
23004	S78	74	78	2000	86	11
23408	S79	52	94	2000	53	8
23408	S80	79	78	2000	53	4
23408	S81	79	78	2000	53	4
23408	S82	71	97	2000	53	9
23408	S83	73	94	2000	53	7
23408	S84	81	78	2000	53	6
23408	S85	77	75	2000	53	2
23408	S86	75	76	2000	53	0
23408	S87	70	65	2000	53	2
23408	S88	69	62	2000	53	5
23408	S89	74	66	2000	53	3
23408	S90	71	67	2000	53	0
23408	S91	70	66	2000	53	0
23408	S92	67	65	2000	53	1
23408	S93	60	66	2000	53	1
23408	S94	59	72	2000	53	0
23408	S95	59	72	2000	53	0
23408	S96	57	74	2000	53	1
23408	S97	82	80	2000	53	6
23408	S98	53	42	2000	50	11
23408	S99	46	63	2000	50	13
23408	S100	102	18	2000	54	30
23408	S101	117	33	2000	54	10
23408	S102	129	35	2000	54	13
23408	S103	119	77	2000	54	14
23408	S104	107	93	2000	54	33
23408	S105	198	71	2000	55	1
23408	S106	65	95	2000		
23804	S107	169	70	2000	61	19
23804	S108	85	6	2000	57	0.5
23804	S109	162	53	2000	62	28
23804	S110	58	90	2000	64	3
23804	S111	57	87	2000	64	2
23804	S112	88	89	2000	64	18

23804	S113	119	95	2000	61	25
23804	S114	125	98	2000	61	20
23810	S115	134	33	2000	67	3
23810	S116	137	32	2000	67	1
31813	S117	174	29	2000	96	5
33007	S118	113	21	2000		0
33007	S119	111	9	2000	91	0
33007	S120	115	6	2000	91	0
33007	S121	146	30	2000	91	0
33007	S122	137	16	2000	91	3.5
33408	S123	173	12	2000	100	2
33411	S124	96	6	2000	102	2
33411	S125	96	13	2000	102	2
33411	S126	94	29	2000	102	0
10206	S127	170	93	2001	72	1
10206	S128	69	86	2001	69	1.5
10206	S129	147	97	2001	72	11
10212	S130	200	12	2001	79	2.5
10401	S131	29	13	2001	1	20
10401	S132	58	97	2001		5
10401	S133	58	97	2001		5
10416	S134	62	79	2001	4	2
10416	S135	67	51	2001	4	0.5
11403	S136	57	3	2001	7	1.7
11407	S137	53	56	2001	12	2
13006	S138	138	55	2001	23	0.5
13006	S139	161	38	2001	23	0.3
13006	S140	125	55	2001	23	0.4
13006	S141	159	42	2001	23	0.5
13006	S142	159	43	2001	23	0.1
13006	S143	123	57	2001	23	4.5
13006	S144	159	45	2001	23	0.1
13006	S145	118	60	2001	23	10
13006	S146	162	50	2001	23	2
20205	S147	122	75	2001	104	2
20205	S148	68	93	2001		1
20205	S149	68	93	2001		1
20205	S150	68	93	2001		1
20205	S151	66	98	2001		1
20205	S152	66	97	2001		1
20205	S153	66	96	2001		1
23008	S154	83	46	2001	88	8
23408	S155	135	43	2001	54	13
23408	S156	114	60	2001	54	2
23804	S157	33	90	2001		24
23810	S158	167	3	2001	67	4
23810	S159	160	-5	2001	67	7
31813	S160	189	8	2001	96	8
31813	S161	178	11	2001	96	5
31813	S162	167	37	2001	96	2
33408	S163	68	71	2001	97	14
11605	S164	13	87	2003		1
11605	S165	9	87	2003		0.5
11605	S166	30	49	2003	29	8
10212	S167	19	105	2004	83	20
23804	S169	31	139	2004	61	12
23804	S170	35	134	2004	41	14
23804	S171	96	70	2004	57	3
33007	S172	48	170	2004	91	21

33411	S173	26	114	2004	102	40
10416	S174	85	17	2006	4	3
10416	S175	85	17	2006	4	3.5
11403	S176	8	28	2006	6	41
11611	S177	17	31	2006	38	2
13024	S178	124	48	2006	27	24
10206	S179	121	80	2007	no tag	3
10206	S180	44	51	2007	56	5
10206	S181	113	?	2007	no tag	1
10206	S182	158	95	2007	no tag	7
10206	S183	50	41	2007	56	1
10206	S184	173	98	2007	no tag	4
10206	S185	45	30	2007	74	13
10206	S186	173	97	2007	no tag	1
10206	S187	173	97	2007	no tag	1
10206	S188	173	97	2007	no tag	1
10206	S189	85	38	2007	70	5
10206	S190	182	44	2007	no tag	2
10206	S191	175	44	2007	no tag	1
10206	S192	95	37	2007	70	12
10206	S193	159	40	2007	no tag	6
10206	S194	168	93	2007	no tag	0
10206	S195	170	90	2007	no tag	0
10206	S196	85	21	2007	71	9
10206	S197	171	83	2007	no tag	0
10212	S198	191	97	2007	80	17
10212	S199	181	20	2007	85	1
10212	S200	187	96	2007	80	12
10212	S201	186	96	2007	80	7
10212	S202	182	97	2007	80	5
10212	S203	173	20	2007	85	2
10212	S204	168	22	2007	85	3
10212	S205	159	70	2007	80	12
10212	S206	185	64	2007	80	30
10212	S207	174	50	2007	78	25
10212	S208	163	25	2007	85	9
10401	S209	34	90	2007	no tag	4
10401	S210	33	86	2007	no tag	5
10401	S211	18	51	2007	1	9
10401	S212	51	90	2007	no tag	3
10401	S213	23	50	2007	1	9
10416	S214	76	45	2007	4	3
10416	S215	47	43	2007	4	6
11403	S216	112	48	2007	8	2
11403	S217	104	20	2007	9	7
11403	S218	35	67	2007	6	14
11403	S219	40	79	2007	6	8
11403	S220	104	20	2007	9	4
11403	S221	101	17	2007	9	14
11403	S222	86	84	2007	6	5
11403	S223	109	10	2007	9	3
11403	S224	59	42	2007	6	15
11403	S225	64	43	2007	6	19
11403	S226	190	18	2007	no tag	4
11403	S227	115	8	2007	9	5
11403	S228	119	9	2007	9	2
11403	S229	171	27	2007	no tag	5
11403	S230	140	32	2007	9	13
11403	S231	94	19	2007		

11403	S232	94	19	2007		
11403	S233	100	31	2007		
11403	S234	98	29	2007		
11403	S235	100	25	2007		
11403	S236	100	25	2007		
11403	S237	97	19	2007		
11403	S238	97	25	2007		
11407	S239	139	51	2007	16	2
11605	S240	14	16	2007	33?	1
11605	S241	14	16	2007	33?	1
11605	S242	14	16	2007	33?	1
11605	S243	14	16	2007	33?	2
11605	S244	185	23	2007	34	3
11605	S245	185	23	2007	34	3
11605	S246	185	23	2007	34	3
11605	S247	185	23	2007	34	3
11605	S248	178	5	2007	34	2
11605	S249	183	5	2007	34	7
11605	S250	178	5	2007	34	2
11605	S251	178	5	2007	34	2
11605	S252	178	5	2007	34	2
11605	S253	178	5	2007	34	2
11605	S254	178	5	2007	34	2
11605	S255	178	5	2007	34	2
11605	S256	189	3	2007	34	15
11605	S257	9	16	2007	35	3
11605	S258	10	14	2007	35	2
11605	S259	15	16	2007	35	5
11605	S260	24	10	2007	30	3
11605	S261	151	3	2007	34	4
11605	S262	24	14	2007	no tag	4
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11605	S264	69	62	2007	no tag	4
11605	S265	12	85	2007	28	7
11605	S266	186	7	2007	34	
11605	S267	194	5	2007	34	
11611	S268	22	65	2007	38	0
13006	S269	77	44	2007	21	15
20205	S270	175	5	2007	107	14
20205	S271	21	65	2007	114	1
20205	S272	22	43	2007	114	15
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20205	S276	81	90	2007	no tag	2
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23004	S278	106	31	2007	86	8
23004	S279	78	53	2007	86	3
23004	S280	112	82	2007	86	3
23004	S281	119	68	2007	86	3
23004	S282	118	67	2007	86	2
23008	S283	76	13	2007	88	11
23008	S284	76	10	2007	88	12
23008	S285	82	12	2007	88	3
23008	S286	72	17	2007	88	12
23408	S287	39	90	2007	53	5
23408	S288	186	90	2007	55	9
23408	S289	87	42	2007	53	2
23408	S290	43	86	2007	53	1

23408	S291	45	99	2007	53	4
23408	S292	47	97	2007	53	3
23408	S293	74	55	2007	53	13
23408	S294	66	62	2007	53	4
23408	S295	68	45	2007	53	17
23804	S296	187	20	2007	62	6
23804	S297	186	20	2007	62	5
23804	S298	133	90	2007	61	4
23804	S299	177	39	2007	62	1
23804	S300	174	24	2007	62	5
30408	S301	194	22	2007	109	1
30408	S302	195	23	2007	109	2
31813	S303	196	8	2007	96	8
31813	S304	196	3	2007	96	12
31813	S305	163	22	2007	96	10
31813	S306	163	20	2007	96	15
31813	S307	159	23	2007	96	6
31813	S308	159	23	2007	96	6
31813	S309	159	21	2007	96	10
31813	S310	160	20	2007	96	12
33007	S311	41	29	2007	90	4
33007	S312	42	30	2007	90	5
33007	S313	46	29	2007	90	2
33007	S314	46	27	2007	90	4
33007	S315	47	26	2007	90	5
33007	S316	47	28	2007	90	2
33007	S317	48	27	2007	90	4
33007	S318	54	34	2007	90	1
33007	S319	39	32	2007	90	12
33007	S320	46	72	2007	89	4
33007	S321	60	38	2007	90	8
33007	S322	67	65	2007	89	7
33007	S323	71	65	2007	89	10
33007	S324	158	29	2007	91	1
33007	S325	32	54	2007	90	2
33007	S326	64	30	2007	89	2
33007	S327	65	84	2007	89	8
33007	S328	65	84	2007	89	8
33007	S329	54	56	2007	89	1
33007	S330	185	82	2007	no tag	20
33007	S331	49	26	2007	90	5
33007	S332	71	80	2007	89	6
10206	S333	175	66	2008	75	0
10206	S334	75	45	2008	70	10
11403	S335	99	27	2008	9	4
11407	S336	86	33	2008	14	10
13006	S337	7	18	2008	18	3
23004	S338	102	82	2008	86	1
23004	S339	75	82	2008	86	3
23004	S340	76	70	2008	86	2
23004	S341	81	80	2008	86	5
23004	S342	86	62	2008	86	5
23408	S343	70	71	2008	53	3
33007	S344	41	52	2008	90	2
13006	S345	44	10	2009	18	11
13006	S346	70	18	2009	21	6
13006	S347	77	77	2009	22	9
13006	S348	82	72	2009	22	2

13006	S349	81	79	2009	22	6
10206	S350			2010	71	3
10206	S351	110	60	2010	no tag	3
10212	S352			2010	85	3
10212	S353			2010	78	10
10212	S354			2010	80	26
10212	S355			2010	80	15
10212	S356			2010	78	9
10401	S357			2010		12
10401	S358			2010		13
10401	S359			2010		13
10401	S360			2010	1	10
10401	S361			2010	1	0
10416	S362			2010	4	12
10416	S363			2010	4	14
10416	S364			2010	4	45
10416	S365			2010	4	5
10416	S366			2010	4	44
10416	S367			2010	4	40
11407	S368			2010	12	7
11605	S369			2010	untagged pl at	0
11605	S370			2010	untagged pl at	12
13006	S371			2010	20	12
13006	S372			2010	20	14
13006	S373			2010	23	3
13024	S374			2010	26	8
13024	S375			2010	26	4
13024	S376			2010	26	6
13024	S377			2010	26	2
13024	S378			2010	26	1
13024	S379			2010	26	4
13024	S380			2010	26	6
13024	S381			2010	26	3
20205	S382			2010	107	31
20205	S383			2010	105	19
20205	S384			2010	105	4
20601	S385			2010	45	2
20607	S386			2010		26
20607	S387			2010	51	20
23004	S388			2010	86	2
23408	S389			2010		8
23408	S390			2010	54	32
23408	S391			2010	54	34
23408	S392			2010	54	34
23408	S393			2010	54	1
23408	S394			2010	54	39
23408	S395			2010	50	13
23408	S396			2010	54	10
23804	S397			2010	57	0
23804	S398			2010	57	1
23804	S399			2010	57	1
23804	S400			2010	57	2
23804	S401			2010	57	5
23804	S402			2010	60	7
30408	S403			2010	93	3
30408	S404			2010	109	4

30408	S405		2010	109	4
30408	S406		2010	109	4
33007	S407		2010	89	22
33007	S408		2010	89	3
33408	S409		2010	98	24
33408	S410		2010	99	0
33408	S411		2010	101	12
33411	S412		2010	102	2
33411	S413		2010	102	2
33411	S414		2010	102	2
33411	S415		2010	102	2
34206	S416		2010	93	3
10206	S417		2011	75	1
10206	S418		2011	75	2
10206	S419		2011	73	66
10212	S420		2011	83	11
10212	S421		2011	85	2
10212	S422		2011	80	8
10212	S423		2011	78	14
10401	S424		2011	1	10
10401	S425		2011	3	40
10401	S426		2011	1	79
10416	S427		2011	4	8
11403	S428		2011	8	49
11403	S429		2011	7	49
11403	S430		2011	7	54
11403	S431		2011	7	79
11403	S432		2011	7	71
11403	S433		2011	7	53
11403	S434		2011	8	40
11403	S435		2011	8	38
11403	S436		2011	8	1
11403	S437		2011	8	1
11403	S438		2011	8	6
11407	S439		2011	14	3
11605	S440		2011	33	3
11605	S441		2011	33	4
11611	S442		2011	39	4
13006	S443		2011	23	8
13006	S444		2011	23	5
13006	S445		2011	23	2
13006	S446		2011	23	1
13006	S447		2011	23	0
13006	S448		2011	23	2
13006	S449		2011	21	0
13006	S450		2011	22	7
13006	S451		2011	22	6
13006	S452		2011	23	9
13006	S453		2011	22	13
13006	S454		2011	24	9
13006	S455		2011	23	3
13006	S456		2011	25	6
13006	S457		2011	23	6
13006	S458		2011	25	26
13006	S459		2011	25	31
13006	S460		2011	22	13
13006	S461		2011	22	0
13024	S462		2011	26	2
13024	S463		2011	194	14

20205	S464			2011	103	44
20205	S465			2011	111	13
33007	S466			2011	89	4
33007	S467			2011	89	3
33007	S468			2011	91	30
33007	S469			2011	89	22
33007	S470			2011	89	26
33007	S471			2011	89	26
33007	S472			2011	91A	57
33007	S473			2011	91A	29
33007	S474			2011	90	1
33007	S475			2011	90	7
33007	S476			2011	90	11
33007	S477			2011	90	10
33007	S478			2011	90	2
33007	S479			2011	90	7
33007	S480			2011	89	1
33007	S481			2011	89	2
33007	S482			2011	89	2
33007	S483			2011	90	2
33007	S484			2011	89	4
33007	S485			2011	89	4
33007	S486			2011	89	2
33007	S487			2011	89	4
33007	S488			2011	89	4
33007	S489			2011	89	4
33007	S490			2011	89	2
33007	S491			2011	91	10
33007	S492			2011	91	5
33007	S493			2011	91	21
33007	S494			2011	91	22
33007	S495			2011	91	40
10212	S496			2012	83	92
10212	S497			2012	83	0
13024	S498			2012	26	10
23408	S499			2012	54	1
30408	S500			2012	109	45
30408	S501			2012	109	9

Appendix B

Newsome update on the current status
of
Physaria douglasii ssp. *tuplashensis*

Update of the Current status of *Physaria douglasii ssp. tuplashensis* on the Hanford Reach National Monument (2012)

Prepared by Heidi Newsome, June 1, 2012

Photo courtesy Jaynee Levy, USFWS

The White Bluffs bladderpod *Physaria douglasii ssp. tuplashensis* is a Candidate species for federal listing under the Endangered Species Act and is considered Threatened in Washington (Washington Natural Heritage Program 2007). Studies of this species began in 1997 on the only known population of *P. tuplashensis*, a species that is endemic to the Hanford Reach National Monument. Studies were conducted primarily by The Nature Conservancy of Washington (TNC) and later continued in cooperation with the Washington Department of Natural Resources Natural Heritage Program (WNHP). The species occurs as a single population in a narrow 17 km long band along the top of the White Bluffs of the Columbia River. The species is a short-lived perennial most closely related to *P. douglasii*, which grows on cobble bars on the Columbia River and is relatively common in sagebrush-steppe from southern British Columbia to northern Oregon and east into Idaho.

The studies of this species had three components: a taxonomic evaluation based on plant morphology and garden studies (Caplow et al. 2007), life history plots placed non-randomly throughout the population, and counts of reproductive individuals in 100 meter transects placed randomly throughout the northern half of the population. The population monitoring transects were sampled annually from 1997-99, in 2002, and were revisited and counted again in 2007. Following the monitoring in 2007, a large wildfire known as the "Overlook fire" burned through the northern portion of the *Physaria* population, and within the area of the established population monitoring transects. Therefore, the population monitoring was conducted again in 2008 – 2012 to assess whether or not the fire had an effect on the *Physaria* population. Data included here are summarized with the previous results of the transect portion of the monitoring study. Results from the life history plots from 1997 to 1999 were presented at the 2000 Washington Rare Plant Conference in Seattle, and a manuscript is available from Peter Dunwiddie, botanist, or Joe Arnett of WNHP.

Following the monitoring of 2002, the data were summarized by Caplow in a report issued in 2003 entitled "Studies of Hanford Rare Plants 2002" (Caplow 2003).

Within the 2003 report, a management objective for *P. tuplashensis* was proposed to be: Maintain at least 10,500 reproductive plants of *P. tuplashensis* in the northern 3.7 km of the White Bluffs population from 2003-2013. If the population remains below 10,500 plants for two years or more, initiate further research into the causes of decline and/or initiate management action(s). Monitoring in 2010 estimated the population at 9,949, however in 2011, and again in 2012 the population rebounded and counts on monitoring transects were well above the 10,500 threshold. Therefore, management actions are probably not yet required based on the current assessment of the population over time. The population varies widely from year to year. Due to the plant's life history of being a short-lived perennial, environmental conditions are important to the expression of the population each season.

The Caplow 2003 report suggests that to adequately assess the population, a full monitoring of the permanent population monitoring transects take place once every three to five years.
Monitoring was conducted in 2007 to capture the 5 year interval suggested by the management objective. Monitoring was again conducted from 2008 through 2011 in order to assess the impact from the "Overlook fire." Map 1 shows the monitoring transects within the population boundary and its association with the perimeter of the "Overlook fire." Map 2 shows the entire extent of the recorded population of *Physaria* in relationship to the perimeter of the "Overlook fire," as well as its relationship to neighboring agricultural development.

Methods
The northern 6 km area of the population contains the sampling plots for the following reasons: the northern portion is the most contiguous and least disturbed portion of the population; there are no evident impacts from nearby agricultural activities; and this portion of the population is generally <1 km from a vehicle track. The sampling area totals 3,700 m in length, resulting in a sampling population of 37, 100 meter long transects. In 1997, ten 100-m transects were chosen at random from this portion of the population for sampling, and the endpoints were permanently marked with rebar stakes. An additional ten transects were added in 1998, for a total of 20 randomly selected permanent monitoring transects, selected from the possible 37 transects. All flowering plants were counted along each transect, and tallied according to their location: "Top" plants are those growing on the top of the bluff, "caliche" plants are growing in the intersection with the caliche layer exposed at the top of the bluffs, and "slope" plants are growing below the caliche on the upper slope. Plants were surveyed in mid-May to early June in 1997-1999, 2002, and 2007-2012.

This season's monitoring took place on May 24, 2012. The current weather for 2012 spring has been slightly cooler, but with near normal levels of precipitation. The Hanford Meteorological Station (http://www.hanford.gov/page.cfm/HMS) recorded for the spring season (March, April and May 2012) slightly cooler than normal temperatures, averaging 53.9°F, 0.1° below normal (54.0°F). Spring season precipitation totaled 1.47 inches, 90% of normal (1.63 inches). This fairly normal spring season followed a relatively mild and dry winter. Temperature for the 2011-2012 winter season (December 2011, January and February 2012) was slightly colder, averaging 33.6°F, 0.6° below normal. Winter season precipitation was fairly dry and totaled 1.86 inches, 65% of normal (2.84 inches).

Results
Data from the 10 permanent transects installed in 1997, supplemented with an additional 10 installed in 1998, provide some indication of the magnitude and direction of trends in the overall population from 1997-2012 (Figure 1). Since these transects were randomly selected only within the northern portion of the site, they may not necessarily represent changes in the overall population. However, they should be representative of changes that occur in over half of the area occupied by *P. tuplashensis*. The population has a large range of variability, but the data strongly suggest that if all 20 transects are sampled the mean will fall within 25% of the estimated true value. There is a definite decrease in confidence intervals between 10 and 20 transects, suggesting that 20 transects should be sampled (Caplow 2003). Figure 2 shows the total number of flowering plants counted during monitoring efforts. Many of the transects in the northern part of the monitoring area had sparser counts of flowering plants compared to transects in the more southern portion of the monitoring area.

The average number of plants per transect over 20 transects counted in 2012 was 914. This was a decrease in average over the 2011 counts, when the average was1592 plants per transect. The counts in 2011 were the highest counts ever recorded during monitoring efforts. As in each monitoring season, the number of plants recorded in 2012 was highly variable, resulting in a standard deviation around the mean of 668. The post-fire data from the period 2008-2012 reflect a highly variable population with a decline from 2008-2010, followed by increases in 2011-2012 to well above pre-fire levels. This season's average of 914 is higher, than the average of 774 plants per transect recorded in 2007, the spring season prior to the fire. Due to variability among the transects, these values are not significantly different.

Multiplying the mean number of plants per transect by the total number of transects in the sampling area (N =37) gives a population estimate for 2012 of 33,800 plants (Figure 3). This is the second season during the post-fire period of 2008-2012 that the population estimate is above the pre-fire population estimate of 28,618 that was recorded in 2007. The population has ranged from an estimated low of 9,949 plants (2010) to a high of 58,887 plants (2011). The population estimate for 2012 is still the second highest recorded since monitoring was initiated in 1997.

Both burned and unburned transects were sampled in 2008-2012. Transects within the burned area perimeter for the "Overlook fire" were counted as burned even if the status of that transect was not noted in the field (N=11). Unburned transects were outside of the burned area perimeter (N=9). In 2012, the average number of plants per transect for burned was 721 while unburned was 1149 (Figure 4). The high level of variability in the data results in no significant difference in the mean between burned and unburned areas, although unburned transects have a slightly higher average number of plants than burned transects.
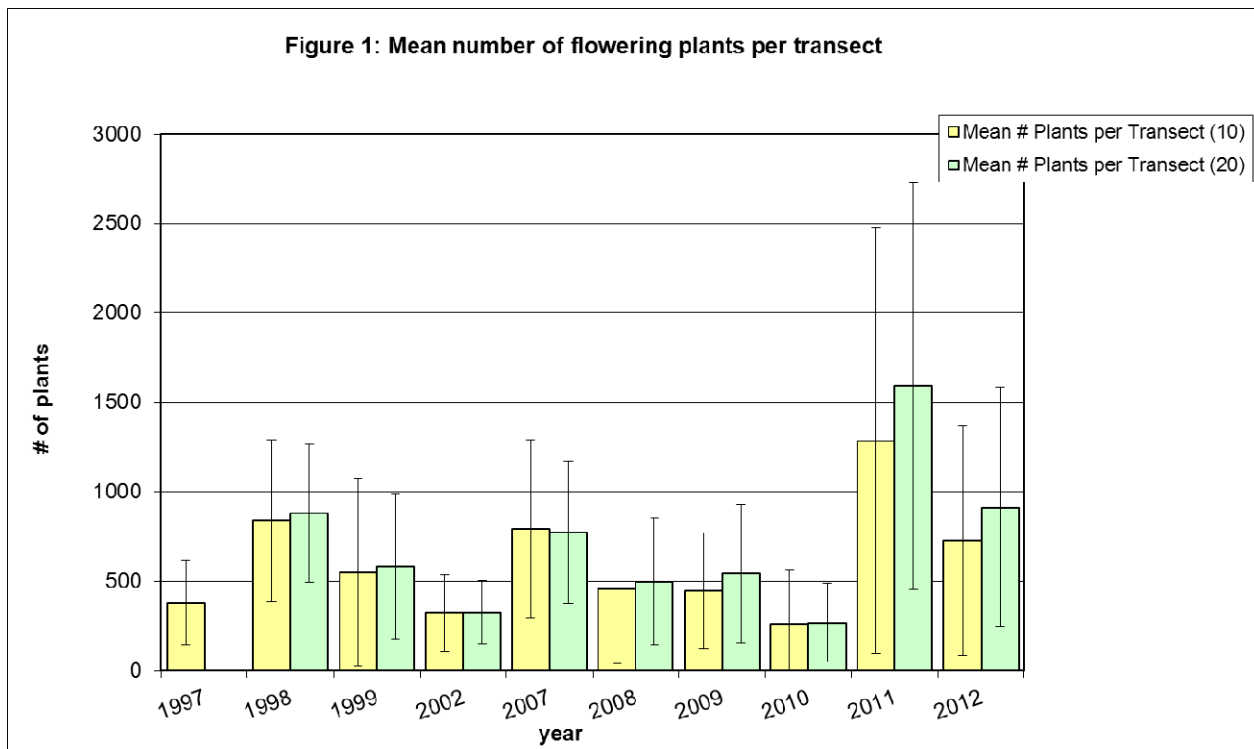
Figure 1: Mean number of flowering *Physaria douglasii ssp. tuplashensis*is plants along permanent monitoring transects. Variability shown as one SD above and below the mean.
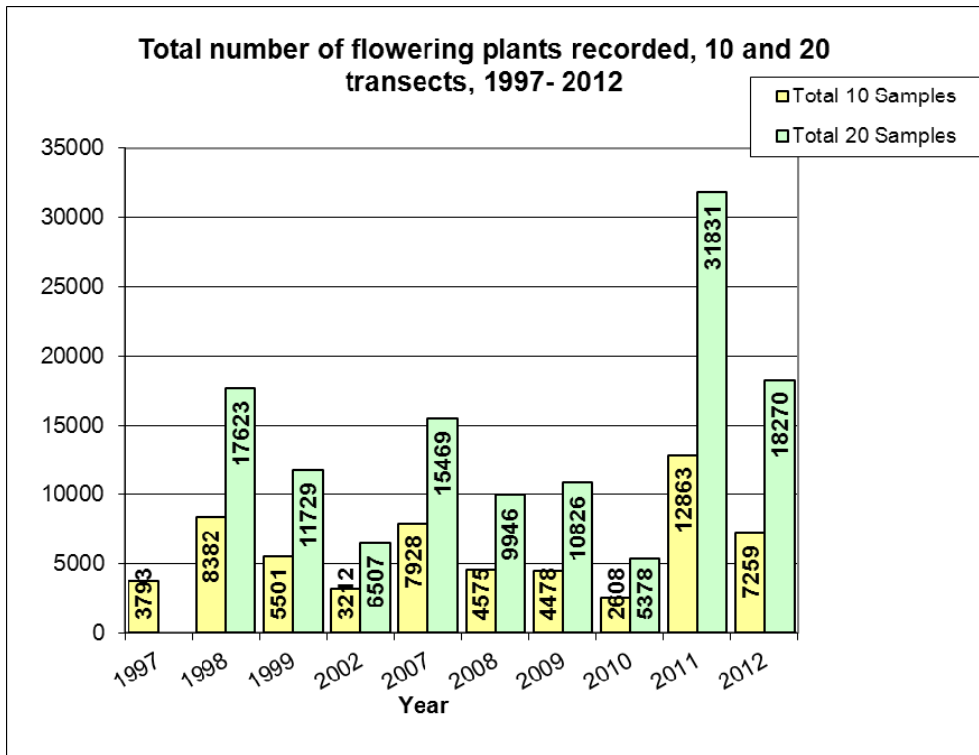
Figure 2: Total number of plants counted along 10 and 20 transects for monitoring of *Physaria douglasii ssp. tuplashensis*is plants along permanent monitoring transects. This represents the minimum value as this is the raw count of plants within transects.
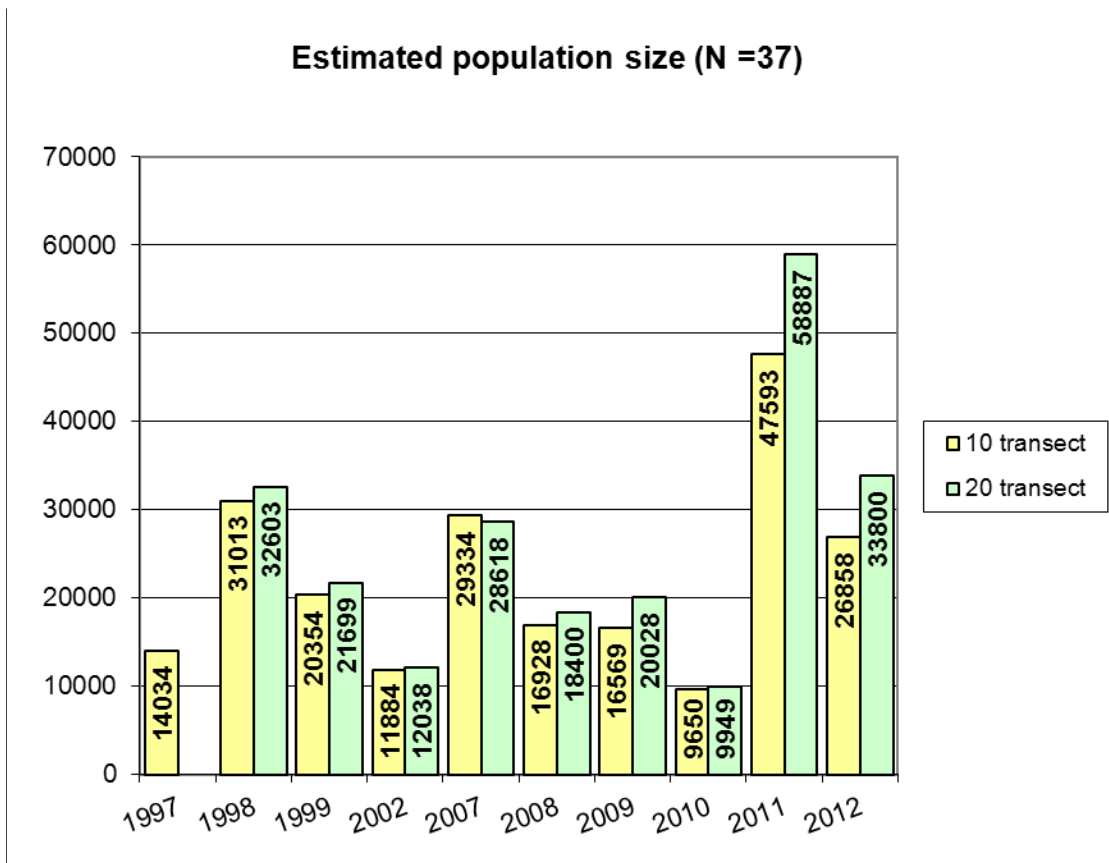
Figure 3: Estimated population size (mean # of plants per transect X total number of transects {N =37}) of *Physaria douglasii ssp. tuplashensis*is along permanent monitoring transects.
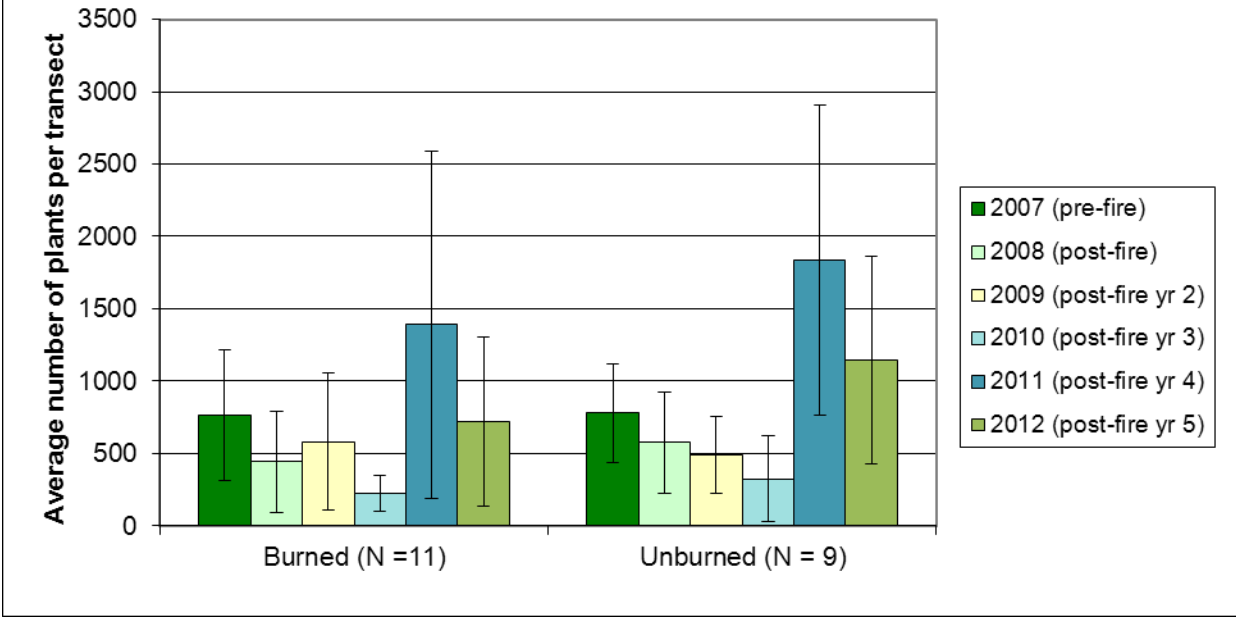
**Figure 4:** Mean number of flowering *Physaria douglasii ssp. tuplashensis*is plants along permanent monitoring transects, burned transects versus unburned transects, for all transects. Transects within burned area perimeter of the "Overlook fire" assumed burned. Variability shown as one SD above and below the mean.

Conclusions: The 2012 monitoring of *Physaria douglasii ssp. tuplashensisis* revealed that the plant population was still above population estimates recorded in 2007 before the fire. The 2012 season is the second highest population after the 2011 season when the population exceeded any of the previously documented population estimates recorded since monitoring began in 1997. Transects recorded as burned after the Overlook fire seemed to have rebounded, but perhaps not as strongly as the unburned transects. The unburned transects seemed to have slightly higher counts than the burned transects; however the data have too much variability to discern a difference with any confidence. The 2012 season provides the fifth year of post-fire data.

   Although the area where the bladderpod grows is in conservation status as part of the Hanford Reach National Monument, wildfire and invasion of non-native species have been identified as threats to the existing population (see Map 2). Irrigated agriculture adjacent to the Monument is also identified as a potential threat. In light of the information in this report related to the species response following wildfire, it does not seem that wildfire is as significant a threat as previously thought. The population seems to be able to recover after fire, under normal environmental conditions. The bluff area where the plants grow does not support dense vegetation and has a low level of "fuel" for fire to carry through. Because of these features of the White-bluffs bladder-pod habitat, the plant may not be as vulnerable to fire as previously thought.

   Continued monitoring of this species is recommended, the monitoring can be completed in a single day with relatively low effort, and additional monitoring in 2013 might be advantageous and informative of the natural variability in this rare species. At the current time, the listing status of this species could be reviewed with this additional information. The population seems stable, although fluctuates widely with environmental conditions. An analysis that would incorporate variables such as precipitation and temperature as covariates could be conducted to possibly determine the relationship between environmental conditions and plant response.

   The management action threshold identified by Caplow (2003) suggests that a management objective for the White Bluffs bladderpod could be **"Maintain at least 10,500 reproductive plants of *Lesquerella***

5

(Physaria) tuplashensis **in the northern 3.7 km of the White Bluffs population from 2003-2013. If the population remains below 10,500 plants for two years or more, initiate further research into the causes of decline and/or initiate management action(s)."** Because the 2012 season has shown that the population has rebounded for the second consecutive year to above the 10,500 level for management action, no further action, beyond monitoring, is required at this time.

Acknowledgements:
Thank you to J. Abel and K. Abel who volunteered to help collect the data during the 2012 season. Thank you to Richard Albers, U.S. Fish and Wildlife Service from San Luis National Wildlife Refuge Complex, California, for assisting in the monitoring.   Thank you to Joseph Arnett of Washington Department of Natural Resources, Natural Heritage Program, for assisting with monitoring and for reviewing this report.

Deputy Project Leader Larry Klimek, Assistant Refuge Manager, Jan "Jack" Beaujon, Wildlife Biologist Kevin Goldie, and Jaynee Levy, Visitor Services Park Ranger assisted with monitoring in 2012.

References
Washington Natural Heritage Program. 2010. Endangered, threatened, and sensitive
        plants of Washington with working lists of rare non-vascular species. Department of Natural Resources, Olympia, Washington. Current list is on-line at http://www.dnr.wa.gov/nhp/refdesk/lists/plantrnk.html

Caplow, F. 2003. Studies of Hanford Rare Plants 2002. Natural Heritage Report 2003-04. Washington Natural Heritage Program, Department of Natural Resources, Olympia, Washington.

Caplow, F. E., P. W. Dunwiddie, D. N. Reynolds, K. A. Beck. 2007. Evidence for recognition of Physaria tuplashensis (Brassicaceae). Submitted to Madrono.

Appendix A:

Photos of monitoring in 2012.

White-Bluffs Bladder-pod and bluff habitat.

Heidi Newsome, USFWS, and Joseph Arnett, WDNR-NHP, partnership for conducting monitoring counts.

Joseph Arnett, Washington Department of Natural Resources, Natural Heritage Program conducting monitoring on steep bluff.

Monitoring showing upper, caliche or "mid" and lower slope counting technique. Pictured are Larry Klimek, Heidi Newsome and Rich Albers, conducting monitoring.

White Bluffs Bladderpod
Population Monitoring Transects
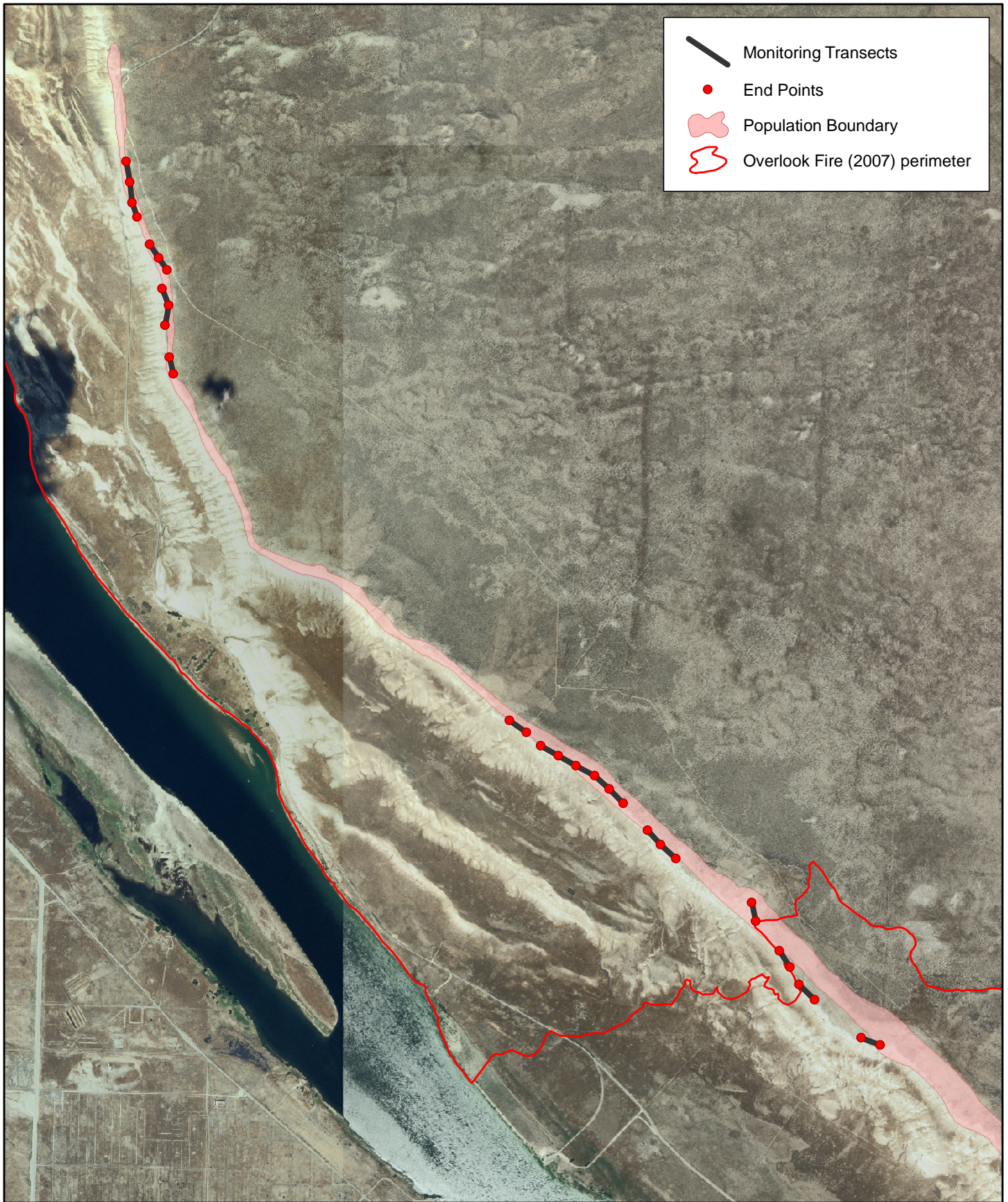
Legend:
- Monitoring Transects
- End Points
- Population Boundary
- Overlook Fire (2007) perimeter
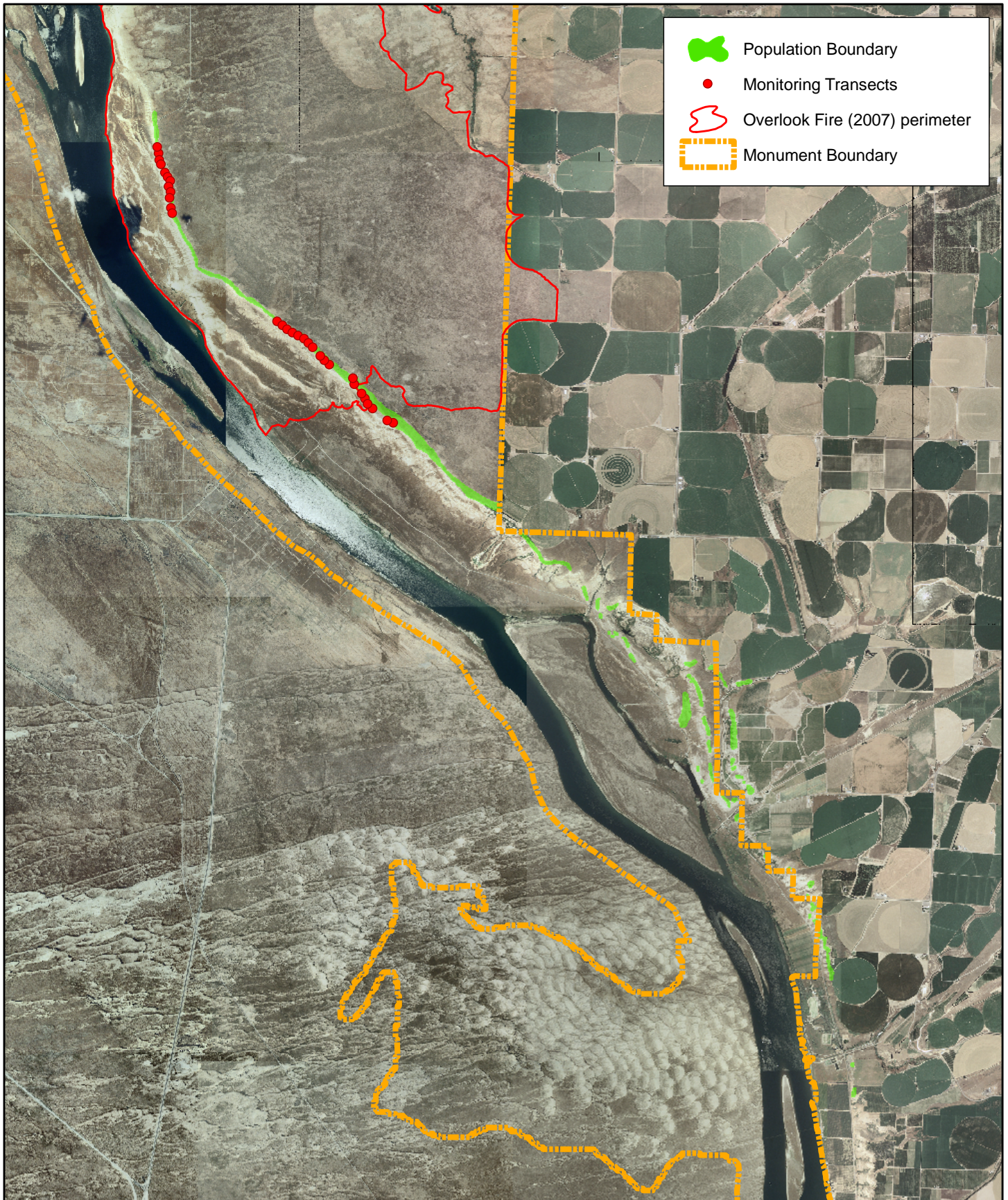
N

0   1,000
Meters

White Bluffs Bladderpod
Population Boundaries

Legend:
- Population Boundary
- Monitoring Transects
- Overlook Fire (2007) perimeter
- Monument Boundary

N

0   4,000
Meters

Map Name: WBBP_PopulationBoundaries.mxd
Map Date: 26-Jun-2008

Appendix C

Monitoring Methodology
for
Eriogonum codium
Population Viability Analysis

Monitoring Methodology
for
Eriogonum codium

(Umtanum desert buckwheat)

Population Viability Analysis

2013

Modified from a 1997 methodology
by
Kathryn Beck,
Calypso Consulting
Bellingham, WA

Joseph Arnett
Rare Plant Botanist
Washington Natural Heritage Program
Washington Department of Natural Resources

Eriogonum codium data collection for Population Viability Analysis

Population Viability Analysis (PVA) of *Eriogonum codium* was initiated in 1997 (Beck 1999), and a layout of randomly selected permanent plots was established within the population on Umtanum Ridge for this purpose. Data has been collected in every year since on randomly selected plants within these plots. In 2007, PVA was conducted with data from the first 10 years (Caplow et al. 2007). This protocol has been prepared to document and clarify the methodology used for that data collection.

General guidelines

The habitat for *Eriogonum codium* is exposed, loose, gravel, and the plants appear to be particularly vulnerable to trampling. Precautions should be taken at all times to minimize impacts and, especially, to avoid trampling.

- Limit the number of people working within the population and move slowly and carefully, watching where you are going.

- Smooth-soled shoes may minimize impact; in rattlesnake country, open-toed footwear is not recommended.

- Enter the population only when necessary; travel from one area to another away from the population.

- Pile equipment outside of the population.

- If a plant is badly trampled, mark it and photograph it for future monitoring.

- Handle the plants carefully; the branches and inflorescences are brittle and break easily.

- Umtanum Ridge can have extremely severe weather, including high wind and thunder storms. Reschedule monitoring if it is not possible to continue without risk to people or to the plants.

Materials as a group

Key to the gate off State Route 24
Notification of Hanford Patrol and our Department of Energy sponsor
Security badges for all participants
A hammer, stakes, and tags for replacing lost markers

Materials per team, typically consisting of two people.

A copy of this methodology document
Previous year's data sheets and compiled data from the previous two or three years for references
Two metric measuring tapes (one at least 50 m; one at least 25 m)
A data sheet for each plot (approximately 30 total). It is prudent to include a set of write-in-the-rain datasheets as back-up, though the likelihood of rain is low.
A metric measuring stick or retractable tape up to 2 meters long-one per team
A 1 x 2 meter quadrat. Ours are made of pvc pipe and calibrated into cm along each side.
Clipboard, pencil, and eraser

Plot layout

Approximately 30 1 x 2 m permanent plots were randomly established within the area of greatest density of *E. codium*. The following paragraphs describe the arrangement of the plots. It is a fairly complex layout, but it makes sense once it has been puzzled out. That each permanent plot is labeled and marked with metal stakes at each corner enables the researcher to locate plots with confidence.

First, three 50-meter baseline transects were laid out passing through the population, and these are marked at each end with iron stakes. Metal tags label the transect ends. The locations of these three baseline transects are shown in Figure 1.
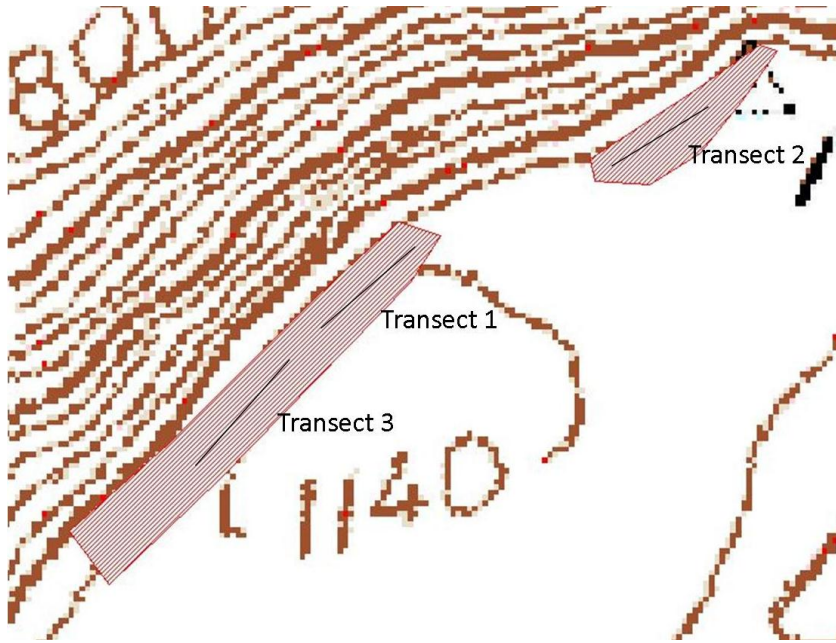
Figure 1. Relative positions of three transects on Umtanum Ridge for monitoring *Eriogonum codium*.

Five 25-meter cross-transects were then laid out perpendicular to each baseline transect at randomly located points along the baseline. These intersections are marked with metal stakes and numbered tags. The uphill end of each cross-transect was placed at the upper edge of the *E. codium* population, and the location along each cross-transect where it intersected the baseline was recorded. Permanent 1 x 2 meter rectangular plots were randomly located along each cross-transect, one above and one below the break in the slope; the upper plot was located in the portion of the population where the slope was 0-10%; the lower plot was located where the slope exceeded 10%. Plots were arranged with the 1 meter edge lying along the cross-transect. See Figures 2, 3, and 4 for maps of the plot arrangements associated with each transect. Figure 5 is a diagram of how plots are named and the orientation of the x and y axes within each plot.

Each plot is identified by a six-digit number: the first two digits indicate the baseline transect number, the second 2 digits indicate the location of the cross-transect along the baseline, and the last two digits indicate the location of the plot along the cross-transect. Thus, plot 02 06 01 is located relative to the second baseline transect, along the cross transect that intersects the baseline at 6 meters, 1 meter from the beginning of that cross-transect. As Table 1 indicates, the cross-transect in this example is positioned so that it intersects the 6-meter mark of the second baseline transect. The zero mark of this cross-transect is 2.37 meters from the baseline.

The *E. codium* plants within each plot have been marked with numbered tags placed on the southwest edge of each selected plant. If more than ten plants were present within a plot, ten of these were randomly selected. Data are collected from these tagged plants for PVA.
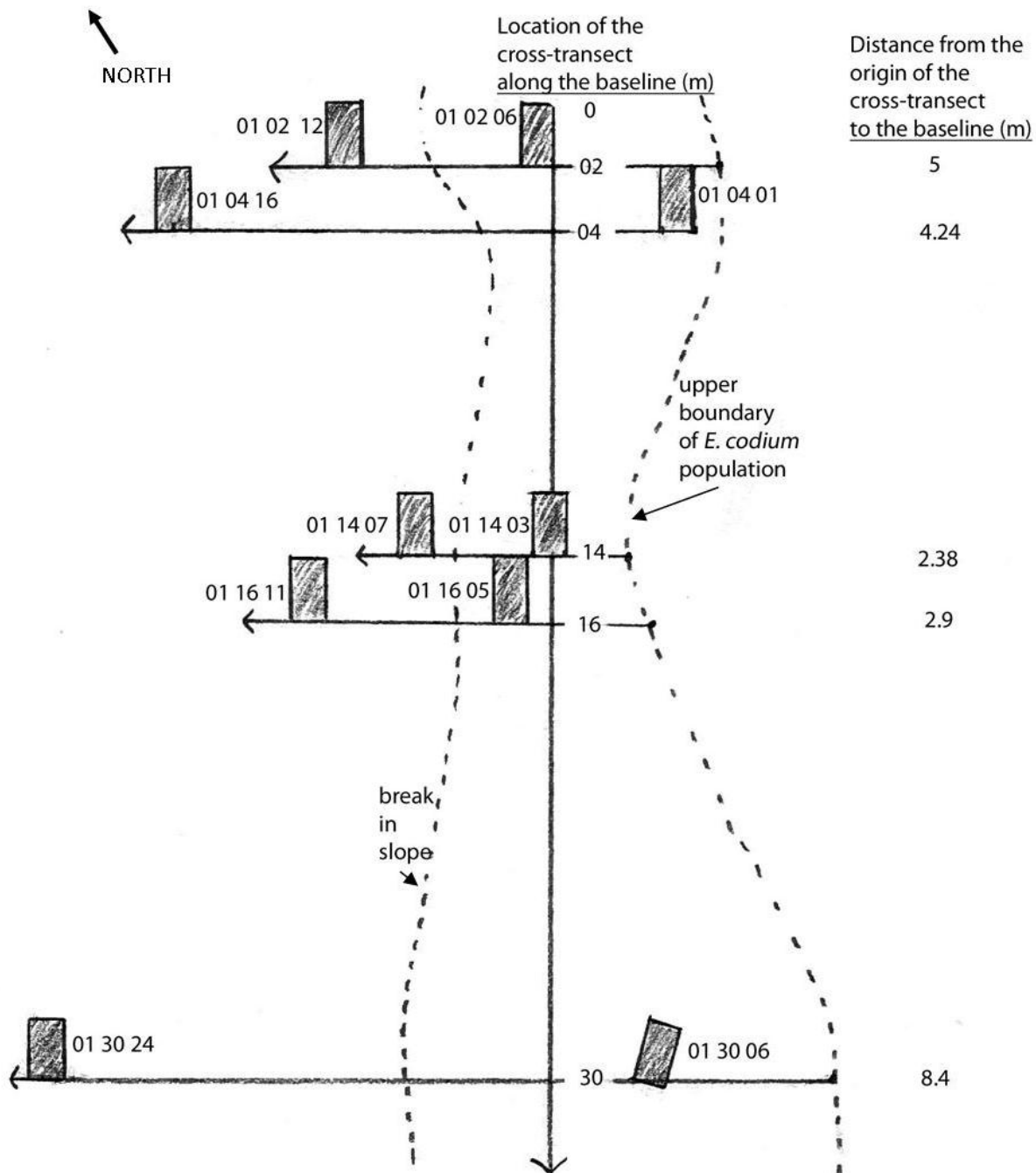
Figure 2. Map of plot arrangement along Transect 1. The heading of this transect is 220 degrees from the zero mark at the northeast end. Identification numbers are positioned next to each plot. **Note that the tag for plot 01 02 12 is located in the southeast corner, because it was not possible to put it in the usual southwest corner.**
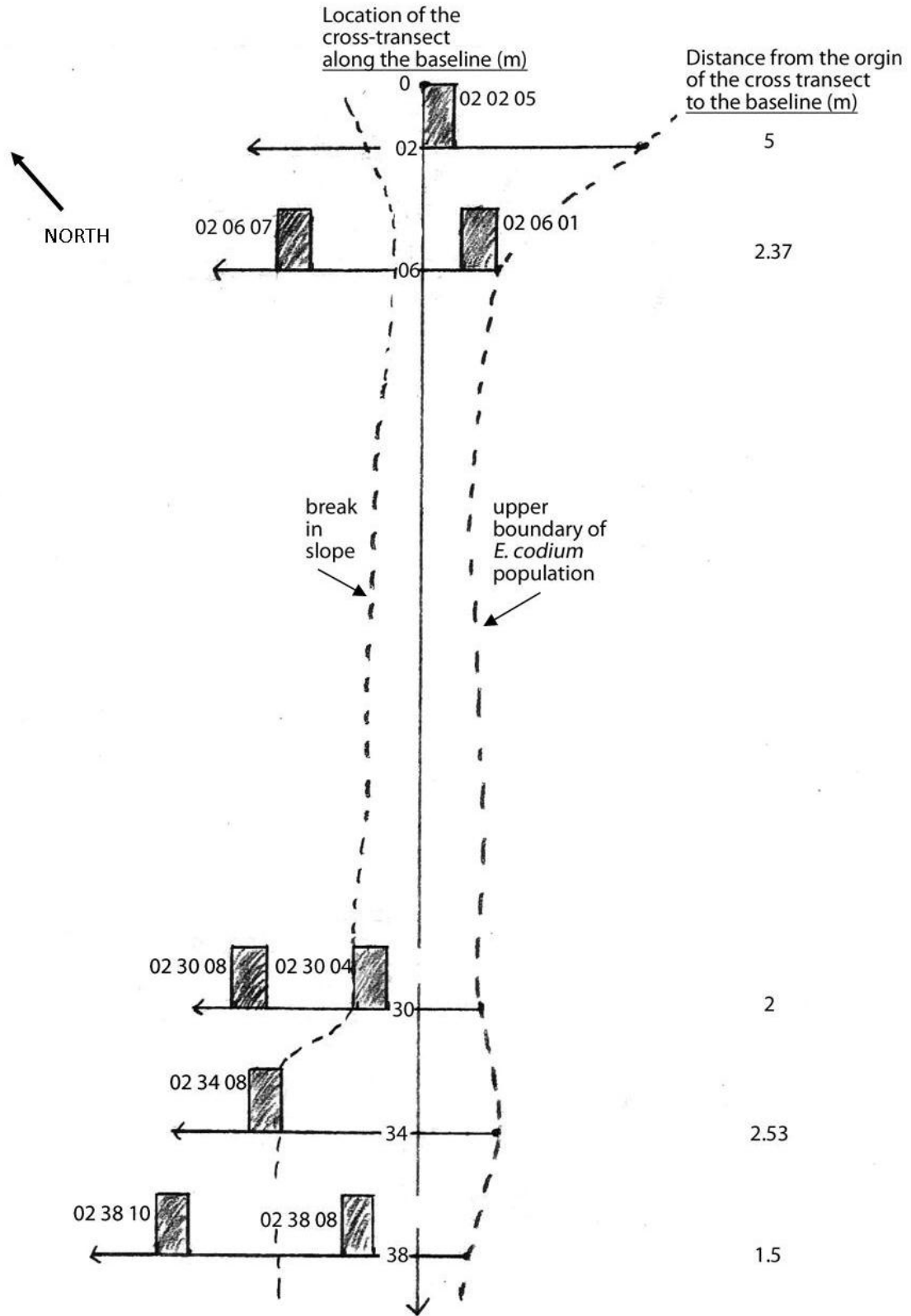
Figure 3. Map of plot arrangement along Transect 2. The heading of this transect is 230 degrees from the zero mark at the northeast end. Identification numbers are positioned next to each plot.
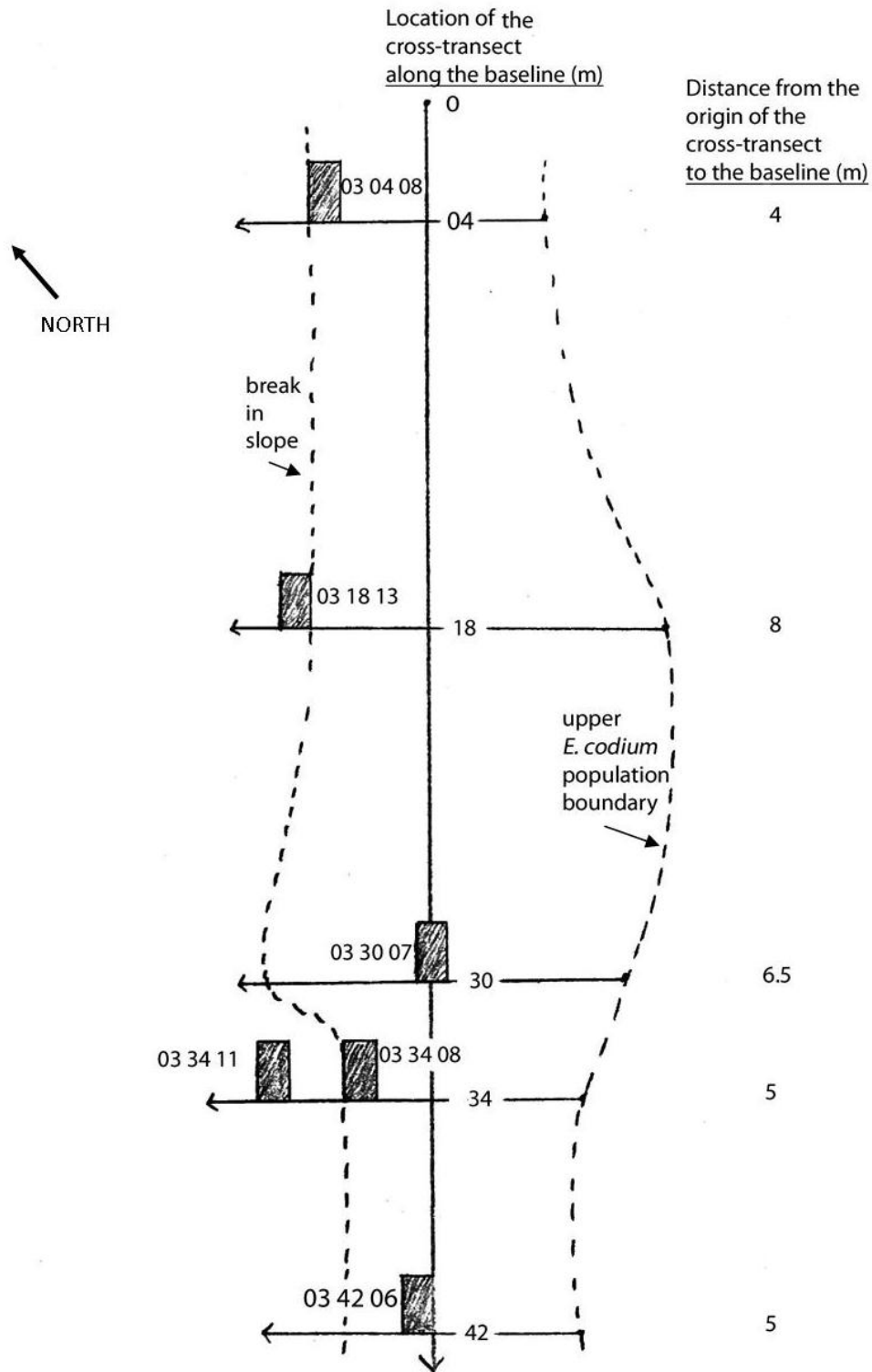
Figure 4. Map of plot arrangement along Transect 3. The heading of this transect is 220 degrees from the zero mark at the northeast end. Identification numbers are positioned next to each plot.
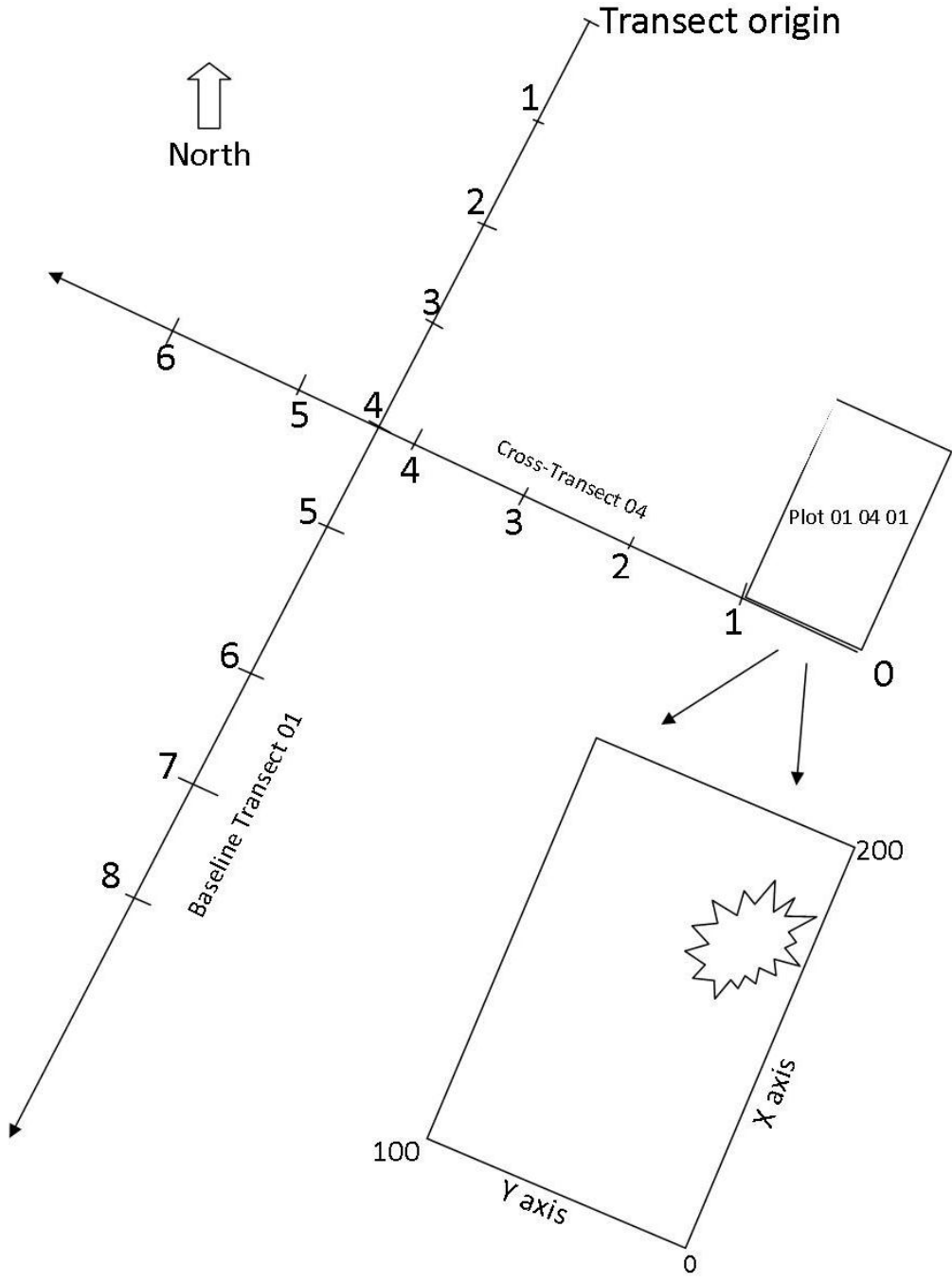
Figure 5. Diagram showing plot numbering, arrangements along cross-transects, and the positions of the x and y axes within each plot. The transects are measured in meters; the coordinates within plots are measured in centimeters. The plant in the expanded plot diagram would be located at 125, 25 cm (the coordinates recorded in the database mark the location of the tag at the southwest edge of the plant, not the center of the plant). The intersections of the cross-transects with the baseline transect, the points of intersection along each cross-transect, and the locations of each plot are presented in Table 1.

Table 1. A synopsis of permanent plot locations relative to baseline transects.

Baseline transect #	Cross-transect intersection along the baseline	Cross-transect intersection along the cross-transect	Upper plot location on the cross transect	Upper plot plant tag numbers	Lower plot location on the cross transect	Lower plot plant tag numbers
01	02	5	06	17, 56, 69-77	12	78-80, 82-85
01	04	4.25	01	1, 3	16	4
01	14	2.38	03	5-11, 195	07	12-16, 112
01	16	2.9	05	28-37	11	38, 39
01	30	8.4	06	17-25	24	26, 27, 192
02	02	5	05	103-108, 111, 114	**	-
02	06	2.37	01	40-49	07	51
02	30	2	04	86	08	87, 88
02	34	2.53	*	-	08	50, 52-55
02	38	1.5	04	57-65	10	67
03	04	4	08	95, 109	**	-
03	18	8	*	-	13	96
03	30	6.5	07	89-91(a-d)	**	-
03	34	5	08	47, 97-101 (99 a,b)	11	102
03	42	5	06	93, 94	**	-

　* The randomly selected plot included no *E. codium* plants and so was not recorded or monitored.

　** The slope did not exceed 10%, and so no lower, or slope plot, was selected.

At each permanent plot location, a 1 x 2 meter quadrat made of pvc pipe is positioned over the four plot corner stakes; care must be taken to locate the origin of the x and y axes, marked off in centimeters, in the correct location, as diagrammed in Figure 5. A data sheet is completed for each plot, including the surveyors' names, the date, and the plot number. Two visits are recorded on each data sheet: a spring visit in late April to record seedlings in each plot, and a summer visit in early July to record dimensions, vigor, and extent of each of the tagged plants.

In seedling monitoring, a careful examination is made of each 1 x 2 meter plot, and any *E. codium* seedlings are noted. For each, the tag number of the nearest adult plant, the distance from it, the x and y coordinates, and the number of visible leaves are recorded. Cotyledons are not included in this count.

In the July monitoring of the adult plants, the date and surveyors' names are again recorded, and data are collected from each of the tagged plants: the length and width of the living portion of the plant, the number of inflorescences, and the percentage of the plant that is dead (using the cover classes noted below in Table 2). Coordinates need not be recorded for tagged plants if they correspond with the database. If the living, leafed-out portion of the plant occurs in two or more large and clearly discrete patches, separated enough so that they might be interpreted as separate plants, each patch should be measured and recorded separately. These data are used in PVA to calculate the area of foliage, and so the analysis is more precise if the intervening empty space is not included. The conditions of the dead plants are also recorded (using the mortality classes noted below in Table 3). When a dead plant is no longer visible, the tag is removed, and this is noted on the data sheet. Notes are also made about any missing tags, changes in tag numbers, or if there appear to be irregularities in how the plants were interpreted in recording the data.

Table 2. Vigor classes of living plants

Class	Percent of the plant that is dead
1	0-1
2	2-5
3	6-25
4	26-50
5	51-75
6	76-100

Table 3. Mortality classes of dead *E. codium* plants

Mortality Class	Description
1	Attempted to leaf out in present year
2	Leaves and inflorescences visible
3	Leaves fragmentary/no inflorescences visible
4	Stems and trunks visible
5	Only the stump is visible
6	Gone

References

Beck, K. 1999a. Research and overview of *Eriogonum codium*, 1995-1998. Prepared for The Nature Conservancy of Washington by Kathryn Beck, Calypso Consulting, August 1999.

Caplow, F, T.N. Kaye, and J. Arnett. 2007. Population Viability Analysis for *Eriogonum codium* (Umtanum desert buckwheat). Prepared for the U.S. Fish and Wildlife Service under Section 6 funding. Natural Heritage Report 2007-04, Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington. June 30, 2007.

Eriogonum codium PVA monitoring data sheet

		Plot #:
Surveyors 1st visit:		Date:
Surveyors 2nd visit:		Date:

Plant # of tagged plants																		
seedlings	x-axis																	
	y-axis																	
	Near adult #																	
	Cm to adult																	
	# of leaves 1st visit																	
	# of leaves 2nd visit																	
live adults	length (cm)																	
	width (cm)																	
	# inflorescences																	
	% dead by class																	
dead plants	Mortality class																	
Notes																		

Percent dead classes	
class	% dead
1	0-1
2	2-5
3	6-25
4	26-50
5	51-75
6	76-100

Mortality classes	
class	description
1	attempted to leaf out in present year
2	leaves and infl. visible
3	leaves fragmentary/no infl visible
4	stems and trunk visible
5	only trunk visible
6	gone